THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

[Registered as a Newspaper.]

Vol. XXVII. No. 664.] LONDON, FEBRUARY 1, 1876. [28th Year.] Price 6d.

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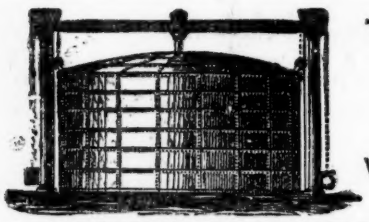

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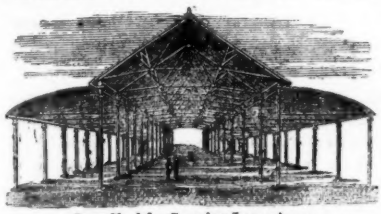

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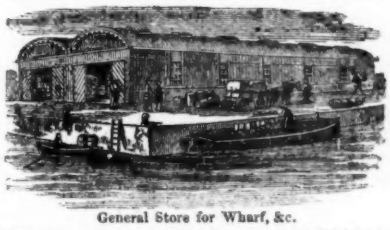

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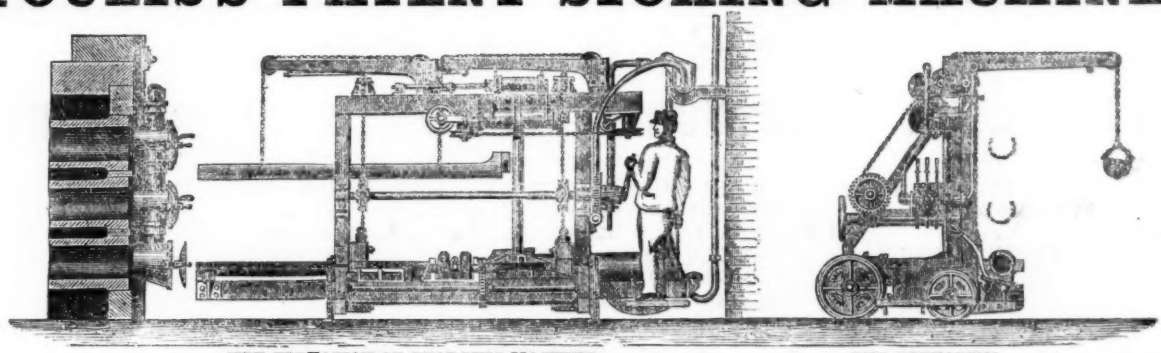

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(*The Drawing Machine will be Illustrated in next week's Advertisement.*)

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TO GAS COMPANIES, ENGINEERS, &c.

These Works are in full operation, and it will be the aim of the New Company not only to keep up the excellent workmanship of their predecessors, but, by the introduction of special machinery, to manufacture **Meters of a higher standard than is usually given, without increasing the cost.**

Special attention is invited to the Compensating Wet Gas-Meter of De Castro and Burton, which is now becoming so generally adopted, and is more simple in construction than any other Compensating or Ordinary Wet Meter. There is but one centre of friction to be overcome by the gas. By its self-adjusting principle it maintains an unvarying water-line; and the reservoir contains sufficient water to supply the Meter for twelve months without attention. It is unaffected by "tilting," and cannot be "flooded" by any pressure.

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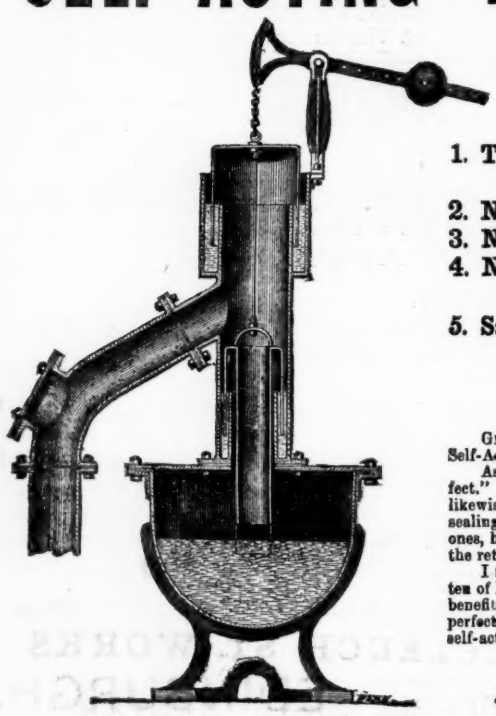

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3. No scurfing is required.
4. Never a choked Ascension-Pipe.
5. Saves Fuel and Wear and Tear.
6. Gets 10 per cent. more Gas out of the Coal, and a higher Illuminating Power.
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8. Requires no attention.
9. Is perfectly automatic in its action.

TESTIMONIAL.

Metropolitan District Asylum, Caterham, Surrey, Dec. 14, 1874.

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I feel that it is quite unnecessary for me to say more on the subject, excepting that, having had ten of Messrs. Chandler's Dip-Pipes in use more than one year, and having experienced the great benefits derived thereby, inasmuch as the yield of gas from the coal is greatly increased, and the retorts perfectly free from carbon and other advantages, and seeing that the same Dip has been made perfectly self-acting by the second patent, I feel convinced that this is the right thing.—Yours obediently,

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OPINION

OF

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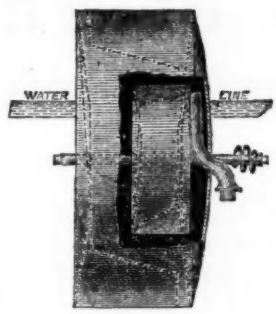
"Your improvement in the Wet Meter is decidedly the best that has been introduced since its invention; exceedingly beautiful and simple, which renders the instrument mathematically correct, and infinitely more accurate than any means in general usage for the measurement of liquids."



OPINION

OF

WILLIAM MANN, Esq., late Superintendent of the Chartered Gas-Works, Blackfriars, London.

"I saw a model of your Wheel to day,* and certainly think it the best addition that the Wet Meter has received since its invention, to ensure correct registration until the closing of the valve."

* Sept. 8, 1874.

From "THE JOURNAL OF GAS LIGHTING," Jan. 5, 1875.

"The changes effected in the construction of the wet meter are such that it now occupies a position which it never held before—that of an unvarying measure. . . . . Both company and consumer are now equally protected, perfect accuracy of measurement is obtained, and that, too, without the least increase of mechanism, or the action of the meter in the least degree being prejudicially affected."

BRITISH ASSOCIATION OF GAS MANAGERS, Leeds, 1875.
Inaugural Address of the President,
JAMES PATERSON, Esq., F.G.S., of Warrington.

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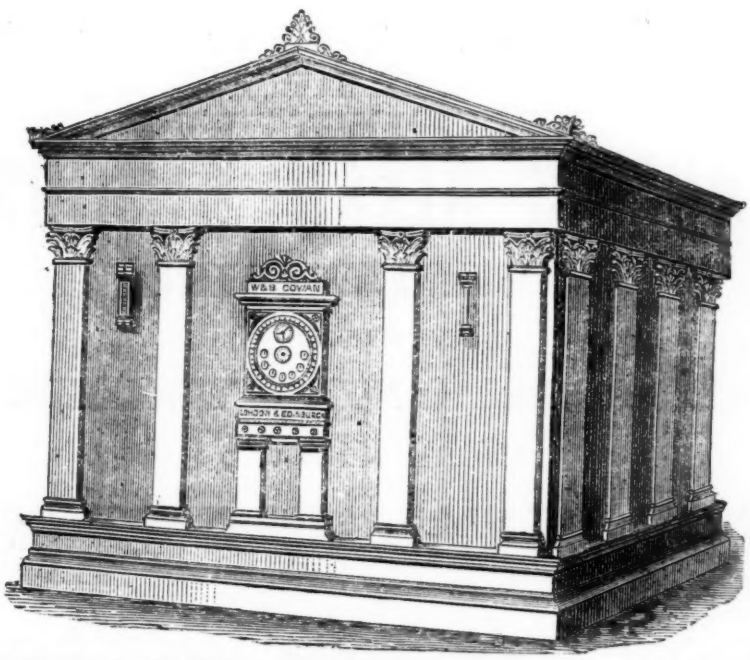

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THE JOURNAL OF GAS LIGHTING,
WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, FEBRUARY 1, 1876.

Circular to Gas Companies.

Obscurity still reigns. Another conference has taken place, to which reporters were not admitted. This time it was between a deputation from the Corporation of London and the Metropolitan Board (the companies not being represented on this occasion), with the Chancellor of the Exchequer; but of what was said, what, if anything, was decided on, we are, of course, perfectly ignorant. Taking, however, another glance over metropolitan gas matters, from zenith to nadir, as we have said, we discern some objects which before escaped our vision. It may be surmised that the design of the deputation was to ascertain, if possible, from a member of the Cabinet, to what proposals the Government would give their support. This metropolitan gas supply business is a miserable question for discussion at a Cabinet Council, and it will, no doubt, be very quickly disposed of, if ever brought forward in Downing Street. But we may here remark again, that any decision the Government may arrive at, on a matter like this, cannot possibly bind their party. On questions of general public policy, a Government may order all their followers into the same lobby; but when private interests are concerned, as in this case, members of Parliament, to whatever party they belong, are in the habit of thinking for themselves; and Mr. Disraeli can no more control the action of his followers on this question, than Mr. Forster can drive Liberal members into a ministerial majority. We might adduce many illustrations of the powerlessness of a Ministry to control the votes of their followers on measures affecting private interests; but we must not stray into general politics. All we wish to do now is, to impress on the minds of our readers that, they may disregard any decision of the Cabinet, if hostile to their interests, and recommend them to "keep their powder dry," in readiness for another parliamentary battle.

Having said so much, we may stop to inquire how far the Government committed themselves on the question last year. Our readers will remember that the original Regulations Bill proposed a standard price of 3s. 9d., with a downward scale of dividend if this standard price were exceeded. This iniquitous proposal was at once denounced by the Government as unjust. We may then fairly assume that any attempt to revive the obnoxious proposal would be at once condemned by the Cabinet. If the low standard price of 3s. 9d. be insisted on by the local authorities, it must be accompanied by either the upward as well as downward scale, or, better still, in our opinion, the Revision Clauses. With regard to these latter, we may express an opinion that they might be revised with advantage, but we expect that, in whatever shape they were put, they would be violently opposed. The deportment of our local authorities in regard to them is that of a bull in relation to a red flag.

The upward and downward scale, the beautiful simplicity of which so captivated Mr. Forster, with the same standard price for all the companies, would, as we have already shown, be unjust to some, and more than just to other, companies. We shall not discuss this part of the question further. It is sufficient for us to know that a majority of the companies have, unwisely as we think, consented to adopt the sliding scale. The Imperial Company appear to wish to stand out, but we fear the promotion of the Bill they have had drawn is a waste of money.

Perhaps, after all, the point which will excite most discussion is the mode in which capital is to be raised in future. On this point the companies have put forward several proposals. The Chartered have actually offered to raise all further capital by way of loan, at interest not to exceed six per cent. The Imperial, by their Bill, express a wish to raise further share capital, limited to a seven per cent. dividend, and to borrow money equal in amount to one-fourth of the share capital raised. The South Metropolitan Company also desire to raise share and loan capital in the usual proportions, but wish that the share capital, with gas at the standard price, may be entitled to ten per cent. We may repeat here that the Commercial Company have obtained an Act, which authorizes them to raise share and loan capital in equal proportions, the share capital, with gas at the standard price, being entitled to a ten per cent. dividend. Which of these proposals finds favour in the sight of the local authorities, and would receive the support of the Government, if an attempt were made to apply it to all the metropolitan companies in a general Act, we cannot say. It may be that no one of them is regarded with entire satisfaction.

The question then arises, what arrangement as to fresh capital would be satisfactory to all parties? Most certainly the proposal of the Chartered would not recommend itself to the amalgamating companies; and we understand that the Chartered Company are willing to abandon it. The proposals of both the Imperial and the South Metropolitan Companies will, no doubt, have to encounter the opposition of the local authorities. How, then, can the matter be arranged?

Proposals have, at various times, been made with success, to divide a ten pound share into two half shares—a preferred and a deferred half share. The preferred half has, if we remember rightly, been considered as preference capital, entitled to five or six per cent., while the deferred half has ordinarily been considered entitled to ten per cent. The days of ten per cent. dividends on new capital are, we fear, past; and now, perhaps, a deferred half share would not be considered entitled to more than seven per cent. We regard an arrangement of this kind as clumsy and complicated; but, no doubt, it serves, to a certain extent, the purpose of keeping down profits and dividends. It would be preferable, in our opinion, to raise all new share capital in the ordinary manner, with seven per cent. or six per cent. dividends, according as preference or ordinary shares were issued.

But the authorities may ask, whether there is not some mode of giving to a company capital, which shall be entitled to no dividends at all, and thereby reducing legal profits to a minimum. Well, there is a way, and that is, by compelling the sale of newly-issued shares by auction to the highest bidder, the premiums realized being so much capital not entitled to dividend. There is a good deal to be said in defence of this plan, and its adoption has, before now, staved off for a time, the opposition of a local authority to a gas company. It was first suggested by Mr. Hawksley, and was adopted as a compromise, in a dispute between the Nottingham Gas Company and the Corporation. It might, therefore, be tried as a temporary expedient in the Metropolis. At first, it was regarded as a bold infringement of the rights conferred on shareholders by the Companies Clauses Act; but now, auction clauses have been accepted by several gas companies, and have become, as we may say, part of the law of the land. For our own parts, we do not like them, but we may admit, for argument's sake, that the public are entitled to that "unearned increment"—the premium on a newly-issued gas

share. We wish the public received the benefit of all unearned increments. We put forth these ideas for what they are worth, and shall continue to wait for revelations, which must soon be disclosed.

We do not like referring to matters more or less personal, but we cannot pass over a discussion at the last meeting of the Common Council of the City of London. The matter before the Court was the election of a Chairman of the Gas and Water Committee. It is the natural ambition of every Common Councilman to be the Chairman of a Committee, and, in succession, of several Committees. The office is one of distinction, and it has been known to produce considerable solid advantage to the occupier. There are some, of course, in the Council so circumstanced, intellectually and otherwise, that they can never hope to attain to the position; but the rule is, that every Common Councilman shall, at some time or other, be the Chairman of a Committee. Naturally then, as in the United States, where every citizen may indulge the hope of becoming President, third terms of office are objected to. It is seldom that more than one term is allowed. We fully sympathize with Mr. Shaw. It is disappointing to die, as a Chairman, in sight of the promised land, and a handsome gift of plate. Mr. Shaw, it may be, lacks original genius, and was content to be led by the nose by the Metropolitan Board of Works; and, notwithstanding the recent "hobnobbing" after-dinner speeches, it seems clear that our two authorities are by no means in accord on the gas and water question. There is now a chance in the City for a man who really understands the questions at issue, and who will not be misled.

We continue this week our notice of the gas and water Bills to be presented to Parliament in the session about to commence. Those we notice to-day are promoted by local authorities, mostly to obtain power to purchase undertakings; and the most remarkable are those put forward by Local Boards in the neighbourhood of Birmingham, with a view to obtain portions of the undertaking recently acquired by the Corporation of that borough. The object of all these Bills is to secure a part of the profit which the Corporation might be expected to make by the supply of gas in the districts of the Boards. This object is, no doubt, laudable; but wefear that if the Bills should pass, some disappointment will result, except, of course, in the case of Walsall. We shall watch with some interest the course of arbitrations, which will ensue if the Bills become law.

It will be seen that two or three Boards and Corporations propose to make compulsory purchases of gas and water undertakings. The Bill which will probably give rise to the strongest contest, is that promoted by the Ramsgate Local Board. It is alleged, in the preamble to this Bill, that the supply of gas and water is unsatisfactory. This is, of course, a figure of speech, such as is often found in preambles. The Bill may be described as impudent. It coolly proposes that, so soon as notice of purchase is given, any person appointed by the Local Board shall have power to enter the offices of either company, examine the accounts, and make whatever inquiries and inspection he may think fit; and this, notwithstanding that the terms of purchase are to be settled by arbitration, and the Arbitrators will have full power to call for all documents and accounts they may require. On what terms the Board hope to obtain the gas undertaking we can hardly guess, but we see that they propose to borrow £70,000 for gas purposes, which, we imagine, will be none too much for the purchase. We do not think the inhabitants of Ramsgate are likely to gain much if the transfer should take place, for, while the maximum price of gas proposed by the Board s certainly lower than that of the company, there is that ugly proposal of an unlimited rate, to make up deficiencies of revenue, which may, at no distant date, result in a heavy imposition on both consuming and non-consuming ratepayers. We expect an animated contest in this case, a report of which will, no doubt, fill many of our columns.

We do not know whether or not the Llandudno and the Stafford Companies are disposed to resist the attempts of the authorities to buy them up by compulsion. In the case of the latter, it is proposed to have the arbitration under the provisions of the Railway Clauses Arbitration Act, 1859. We have glanced over this Act, and the only difference we have discovered in its provisions, and those of the arbitration clauses of the Companies Clauses and the Lands Clauses Consolidation Acts, which are ordinarily invoked, is, that the arbitrators or umpire have thirty days in which to make the award, instead of twenty-one. There is nothing in the Stafford case, so far as we know, to necessitate a long inquiry, or make an award a difficult business.

The Bills we notice to-day will, if passed into Acts, authorize local authorities to add just about two millions to the local debts of the kingdom, for gas and water purposes. As, however, gas and water undertakings are usually productive, means are at hand to pay off the debts, while an essential service is rendered. But we notice a curious fact stated in a schedule to the Halifax Water and Gas Extensions Bill. It is, that the Corporation of Halifax have paid *out of borrowed money*, raised for the purpose of their water undertaking, exactly one-tenth of the sum borrowed, for interest on the money so raised. This has necessitated the opening of a "suspense account," and it would seem to follow that, the ratepayers of Halifax now stand indebted for just one-tenth more than the cash they have received. The money borrowed, we may mention, is £429,685, and the amount paid for interest, on and out of this sum, is £42,808.

Another mare's-nest has been discovered at Leeds. The Corporation, having proved that the gas they supply is more than up to the standard, and that the complaints which have been made were entirely due to the use of bad burners, another fault is now found. It is alleged that the gas is "intolerably noxious in "the process of combustion;" that, in burning, it gives off an offensive effluvium. Now, every tyro in chemistry knows that the products of the combustion of gas, when a full supply of air is maintained, are entirely inoffensive as regards smell. With a limited supply of air, noxious effluvia may be produced, and even with a good supply of air, in a room imperfectly ventilated, the atmosphere may become oppressive. The products of the combustion of gas are, for the most part, water and carbonic acid. There is, usually, some sulphurous acid produced; but we, who have put the matter to the severest test, have never been able to obtain either an olfactory or a chemical proof of the presence of this gas in the atmosphere of a small room, with over thirty gas-lights burning in it. We must then conclude that the new complaint at Leeds is a result of the imperfect ventilation of the rooms in which gas is burnt, and cannot be ascribable to the quality of the gas. How Mr. Woodall and the Gas Committee are to combat this new delusion, we do not see. Perhaps they had better not take any notice of it.

The Lambeth Vestry have sent a memorial to the Board of Trade, stating objections to the amalgamation of the South Metropolitan with any other company, and also to the Bill promoted by the company, unless modifications be introduced. We need not enter into this matter here.

We are now promised two really scientific photometers. By one of the most remarkable discoveries ever made—a discovery which places him in a rank with Newton—Mr. W. Crookes has ascertained that light exerts a certain amount of mechanical action, which is a measurable quantity, according to the intensity of the light. On this fact Mr. Crookes bases a plan for measuring the luminosity of a gas-flame. It has also been discovered that light exercises an influence on the electric conductivity of the metalloid selenium in a certain condition, and by determining the conducting power of this body under the influence of light of varying intensity, Dr. Werner Siemens proposes to estimate the amount of light given off by any luminous body. We shall be able, in the course of a week or two, to give a full account of these discoveries, and of the means proposed for their practical utilization in photometry.

There seems to be a prospect that an agreement may be come to between the Sevenoaks Gas Company and the Local Board, by which all opposition to the Bill promoted by the Company will be avoided. The main point in dispute now is the maximum price. Perhaps it would be well for both parties to split the difference, and make it 5s. 6d. per 1000 feet.

Although all idea of purchasing the gas undertakings of the Metropolis, whether by the local authorities, or by transfer to a hybrid commission, seems to be, for the time, abandoned, we may briefly refer to the notions put forth on the subject by Mr. Silverthorne, in the pamphlet we noticed last week. We may stop for a moment to remark a certain accordance in the opinions entertained by the author, with those expressed in these columns. He considers that "the retention of the ten per cent. dividend" (meaning, of course, the legal maximum) "is the essence of our "gas legislation." He has, however, a preference for the City of London Act, 1868, as a basis for new legislation, while we should prefer an amendment of the Act of 1860, which would give the companies a fair range of price, and place them under the supervision of a public auditor. With a fair range of price, no revision clauses, with their concomitant expenses, would be necessary. Mr. Silverthorne writes in rather indignant terms of the results of the second revision in the case of the Chartered Company; but he rightly, as we did, finds fault with the tribunal rather than the law.

To the upward and downward sliding scale of dividend our author is strongly opposed. He believes that the downward scale, as originally proposed, "might have afforded some con-"siderable protection to the consumer." Undoubtedly it would; but it would have been at the expense of the companies, who, as Mr. Silverthorne admits, are entitled to ten per cent.

Passing to the question of purchase, the author goes on to show how the adoption of the upward and downward sliding scale would enhance the value of certain undertakings, in the event of

purchase. This is tender ground, and we shall not enter upon it, but content ourselves with recommending a study of the pamphlet to our readers. We do not always agree with the author, and we cannot say that we always understand him; but there is a good deal of information in his pages, which, so far as we can see, is quite correct; and as to the opinions expressed, our readers, who have their own, may come to what conclusions they please.

Water and Sanitary Notes.

We passed over, by accident, last week, notice of a matter which we regard as of the greatest importance. It concerns the foundations of houses. The first and most important condition for a healthy house is a sound foundation, and Dr. Tripe has rendered an essential service, by exposing the nature of the material which lies under the basement floors of houses in the outskirts of this Metropolis. It is for the most part shot-rubbish, which is eminently porous, and affords free passage for whatever exhalations may stream up from the underlying subsoil. No wonder that houses built on such stuff are damp and unhealthy. It is in such that cholera and fever find their home, and rheumatism most prevails. Our sanitary authorities seem to treat with contempt all diseases that do not kill, and no one has attempted to trace out the cause of rheumatism, a disease which, perhaps, causes a larger money loss to the industrial classes than any other. We have elaborate calculations as to the loss which results to the community from the cost of funerals, necessitated by the ravages of what are called zymotic diseases; but no one has taken the trouble—and we do not wonder at it—to estimate the loss which results from the prevalence of that labour-incapacitating disease—rheumatism. The causes of this disease have, we rather think, never been studied, and no doctor has had the ingenuity to attribute it to the water supply. Nevertheless, popular opinion ascribes its production to damp dwellings; and we have a notion that popular opinion is right. We hope, then, that whenever the Metropolis Building Act is amended, and that in whatever Act may in the future be passed giving local authorities control over the erection of dwelling-houses, it will be enacted that all basement floors shall have beneath them a bed of concrete, at least one foot in thickness; and if three inches of asphalte were placed upon this, it would be so much the better. We have a strong belief, that if such a provision were rigidly insisted upon, zymotic diseases would be much more rare, and rheumatism much less prevalent.

Dr. Humphrey Sandwith, C.B., who cannot get into the House of Commons, is driven to find some other outlet for his complaints against the London water companies. He finds one in that frequent resource of would-be legislators—letter writing to the *Times*, and another, in lecturing to popular Institutions. Dr. Sandwith might, perhaps, be able to give us some original and interesting information as to the water supply of Kars during the siege, and its influence on the health of the garrison and the inhabitants; but as regards London, he relies entirely on the reports of Dr. Frankland, and the remarks of the Registrar-General, for an opinion as to the quality and effects of theMetropolis water supply. We, therefore, find nothing original in his lecture at the Quebec Institution, and need not further allude to it. We regret extremely that the Athenæum Club is not supplied with water from what the Doctor would consider a purer source; but we are under the impression that the frequenters of that club are a healthy and rather long-lived set—it may be, because they do not drink water unqualified.

The water agitation in the Metropolis, in other respects, shows signs of subsiding. We doubt whether any Bill, having for its object a change in the system of rating, or a change in the source of supply, will be proceeded with in the session about to open. The reasons are obvious enough, the chief being, the absence of any authority to take the control of the undertakings; and then the enormous expense, which a change in the source of supply would involve. We do not think that the inhabitants of the Metropolis will suffer from the delay.

A curious story is told in another column of the indirect pollution of the river Ravensbourne by foul lime, from the works of the Crystal Palace District Gas Company. We make no remarks on the stupidity exhibited by those who took charge of the foul lime. It has been repeatedly pointed out, in these columns, that foul lime is not necessarily a nuisance, and Dr. Voelcker has shown that when properly "weathered," the material has some manurial value. It has further been indicated that foul lime may possibly be "revived" for the purposes of purification. In any case the disposition of it in this instance has had most disastrous results. The Ravensbourne no longer, we believe, supplies water for drinking purposes, except to cattle; but there exists every reason to keep the stream as free from pollution as possible.

GAS BILLS FOR 1876.

(*Continued from page* 120)

The next bill we have to mention is of a somewhat unusual character. It is to authorize the *North British Railway Company* to acquire the *Silloth Gas-Works*, and exercise all the ordinary powers of a gas company. The amount the railway company propose to expend on the gas-works is £2000, and the bill provides that the accounts of the gas undertaking shall be kept perfectly distinct from those of the railway, and in all respects in accordance with the provisions of the Gas-Works Clauses Act, 1871. The gas limits are to be the town of Silloth, in Cumberland. Gas of fourteen candle power is to be supplied at a price not to exceed 6s. 8d. per 1000 feet. For the rest we may say that the railway company seek, by this Bill, all the powers conferred on a gas company.

The *Southport Improvement Bill* is to extend the limits of the borough, and among other things to authorize the Corporation to acquire land for the extension of their gas-works. The Bill proposes a maximum price of 4s. 6d. per 1000 feet for the gas supplied, and, if passed, will authorize the Corporation to borrow £230,000 for gas purposes.

As our readers know, several of the local authorities in the vicinity of Birmingham are promoting bills to acquire power to purchase parts of the gas undertaking now vested in the Corporation of Birmingham under the provisions of the Birmingham Gas Act, 1875. That Act provides that the several authorities may purchase such parts of the undertaking as lie within their districts; and further enacts that the Corporation of Birmingham shall not oppose the Bills of the local authorities, except upon clauses. We may add that the purchase-money is to be settled by agreement or arbitration.

The *Oldbury Local Board Gas Bill*, &c., seeks power to purchase so much of the Birmingham gas undertaking as lies within their district, consisting, we believe, of only mains, lamp pillars, &c., and to acquire land and erect new gas-works. The Board propose to supply fifteen-candle gas at a price not to exceed 4s. per 1000 feet. They ask power to borrow £100,000 for the new works, and such further sum as may be required for the acquisition of the undertaking. Power is sought to raise the money by issuing annuities at a rate of interest not to exceed 5 per cent.

The *Smethwick Local Board Bill* is to empower the Board to purchase that portion of the Birmingham undertaking lying within their district, on terms to be settled by agreement or arbitration. For the purchase and the erection of works the Board seek power to borrow £50,000. Gas of fifteen candle power is to be supplied at a price not to exceed 4s. per 1000 feet.

The *Tipton Gas Bill* is to enable the Local Board to purchase the distributing apparatus within their district, exclusive of trunk mains, conveying gas from the West Bromwich works to localities beyond the district of the Board. The terms are, of course, to be settled by agreement or by arbitration, and the consideration may be a sum in gross or an annual payment. The Board seek power to borrow £25,000 for new works, and such further sums as may be required for the purchase of the existing works. Gas of fifteen candle power is to be supplied at the Birmingham maximum price, 4s. per 1000 feet. Power is in this case also sought to raise the money by the creation of annuities, at interest not to exceed 5 per cent.

The *Walsall Improvement Commissioners Gas Purchase Bill* and the *Walsall Gas Purchase and Borough Extension Bill* are promoted with, in one respect, the common object of effecting the purchase of that portion of the Birmingham gas undertaking lying within the limits of the Borough of Walsall. In this case the two authorities have arranged terms, and the consideration to be paid by the Walsall authority to the Corporation of Birmingham is a yearly sum of £1300, in two half-yearly payments. The second Bill named is to transfer the property, power, and duties of the Improvement Commissioners to the Corporation of Walsall, including, of course, the powers conferred if the first-named Bill should pass. Power is sought in each Bill to borrow £100,000 for gas purposes.

The *West Bromwich Improvement Gas Bill* is to empower the West Bromwich Improvement Commissioners to purchase the distributing apparatus of so much of the Birmingham Corporation gas undertaking as lies within their district. The purchase will not include the Swan Village Works, nor, of course, the trunk mains leading from the works to Birmingham. Power is sought to borrow £50,000 for the purchase of land, and the erection of new gas-works, and such further sum as may be required for the acquisition of the plant, &c., of the Corporation of Birmingham. The gas is to have the illuminating power of fifteen candles, and the maximum price is to be 4s. per 1000 feet. The Bill seeks power to raise the money required, either by the issue of debenture stock at interest not to exceed five per cent., or by the issue of annuities at interest not exceeding four per cent.

In the above Bill the local authorities seek for all the powers, rights, and privileges, usually conferred on gas undertakings in corporate hands. The gas is to be tested under the provisions of the Gas-Works Clauses Act, 1871, which is incorporated.

The next group of bills we notice relate to combined gas and water undertakings. Only one company appears in this group.

The *Llandudno Water and Gas Bill* seeks to incorporate the Llandudno Gas and Water Company with the usual statutory powers. The company have raised and expended share capital to the amount of £17,500, and have borrowed £4250. Power is now sought to raise £32,500 additional capital, the dividends on which it is proposed to limit as usual. The customary borrowing power is prayed. The domestic rates for water proposed vary from seven per cent. to five per cent. on annual value, with the usual extra charges for closets, more than one, and for baths. As regards gas, the illuminating power proposed is fourteen candles, and the price is not to exceed 6s. 3d. per 1000 feet. The Bill seeks all the ordinary powers in connexion with both undertakings.

The following Bills are to authorize the purchase of gas and water undertakings, or the construction of water-works, by local authorities.

The *Campbeltown Burgh and Harbour Bill* is, among other things, to enable the Corporation of that Royal Burgh to purchase the undertaking of the Campbeltown Gas Company, a joint-stock concern. The company have expended share capital to the amount of £1950, and have borrowed and spent a further sum of £3000. The terms of purchase are to be settled by agreement. The Town Council seek power to borrow the sum required for the purchase, and a further £12,000 for gas-purposes. Twenty-candle gas is to be supplied, the price of which is not to exceed 10s. per 1000 feet. With respect to water supply, the Bill is to empower the Council to buy some works constructed by the Duke of Argyll, and make extensions.

The *Kirkcaldy Burgh and Harbour Bill* is a measure similar to the above. It is to enable the Corporation to acquire the undertaking of the Kirkcaldy Gaslight Company by agreement, subject to the approval of a meeting of ratepayers. The consideration agreed upon, it is asked power to pay either in a lump sum, or by annuities, or partly one and partly the other. The capital expended by the company is not stated. The Corporation seek power to borrow any sum they may have to pay down on the completion of the purchase, and a sum sufficient to redeem the annuities which may be granted, and a further sum of £5000 to carry on the undertaking. Twenty-candle gas is to be supplied, at a price not to exceed 7s. 6d. per 1000 feet. As regards water supply, the Bill is simply to increase the number of commissioners, and extend the limits of compulsory supply.

The *Llandudno Improvement Bill* is, first of all, to enable the Improvement Commissioners to effect a compulsory purchase of the Llandudno Gas and Water Company, on terms to be mutually agreed upon, or settled by arbitration, under the Lands Clauses Act. The Commissioners propose to bind themselves to supply fourteen-candle gas, with the maximum price of 6s. 6d., or threepence per 1000 more than the company ask power to charge. In respect of the water undertaking, the commissioners propose the uniform domestic rate of seven per cent. on annual value, with the usual extra charges. Power is sought to borrow £70,000 for the purposes of the Act.

The *Padiham and Hapton Local Board Bill* is, first, to authorize the Board to acquire the undertaking of the Padiham Gaslight and Coke Company, on terms which have been agreed upon. The transfer is to take place as and from December 31, 1874, and the purchase includes the cash balance in the hands of the company. The consideration is annuities, amounting to £1118 17s. 7d. per annum, payable from December 31, 1874. The Board assume the mortgage debt of the company. Power is sought to borrow, at once, £20,000 for the purposes of the Act; and a further sum of £10,000, subject to the approval of the Local Government Board. The water company were bought by the Board some years ago, and by this Bill they seek power to extend the undertaking.

The *Ramsgate Local Board Bill* is promoted by the Board to effect a compulsory purchase of the Ramsgate Water Company, and of the Ramsgate works of the Isle of Thanet Gas Company, the preamble alleging that the supply of water and gas is unsatisfactory. The terms are to be settled by agreement, or by arbitration. The Board propose to supply fourteen-candle gas at maximum prices, regulated by the cost of coal. Thus, if the cost of coal is 20s. per ton, or under, the price of gas is not to exceed 4s.; if above 20s., but more than 25s. per ton, the price of gas is not to exceed 4s. 6d.; and if the cost of coal should exceed 25s. per ton, the price of gas is not to be more than 5s. per 1000 feet. The Board seem to be in doubt, however, as to whether these prices may prove remunerative; for, in a subsequent section (the 91st), they seek power to levy a "gas-works rate, to make up possible deficiencies of revenue," and, moreover, do not, as is usually done, propose a limit to this rate. As regards the water supply, the Board proposes about the usual rates, graduated according to annual rateable value, with the customary extra charges. The other provisions, with respect to water supply, are of a rather stringent character. The Board seek power to borrow £50,000, in respect of the water undertaking, and £70,000 for gas purposes. Only one other provision need be noticed. If any surplus profit should remain, after defraying all charges on the undertakings, the Board propose to apply it in equal moieties in reducing the cost of gas and water to the consumer, and in increasing the district-fund.

The *Stafford Borough Extension Bill*, as the title indicates, is to extend the limits of the borough, and, further, to authorize the Corporation to make a compulsory purchase of the undertaking of the Stafford Gas Company; the terms to be settled by agreement, or by arbitration, under the provisions of the Railway Companies Arbitration Act, 1859. This last is, so far as we remember, a novel proposal in connexion with the purchase of a gas company. In case the purchase is effected, the company's Act is to apply to the Corporation. The consideration may be paid either in a lump sum, or by way of annuities, representing shares in the company. No estimate is given of the cost of purchase, and the Corporation simply ask power to raise such a sum as may be required for the purpose. With respect to water supply, the Corporation propose to construct new works. The powers they seek for are rather stringent, including the laying down of district-meters, to detect waste. The domestic rates are, as usual, graduated according to annual rateable value, with the customary extra charges. The Corporation propose to borrow £50,000 for the purposes of their water undertaking.

In all the above Bills, so far as they relate to gas undertakings, the Gas-Works Clauses Act, of 1871, is incorporated, and all the usual powers are sought. With respect to the water undertakings, also, the customary rights and privileges are prayed for, and, in one or two cases, rather stringent powers are asked for.

The two following Bills are promoted by Corporations, to obtain further powers in connexion with gas and water undertakings:—

The *Halifax Water and Gas Extension Bill* is to authorize the Corporation of Halifax to borrow £100,000 for the extension of their gas-works, and £300,000 for water-works purposes. The Gas-Works Clauses Act, 1871, is incorporated, and fourteen-candle gas, tested in conformity with the provisions of that Act, is to be supplied.

The *Huddersfield Water-Works and Improvement Bill* is to extend the gas and water limits of the Corporation, and to authorize the construction and maintenance of additional works. Gas of fourteen-candle power is to be supplied, and tested by a fifteen-hole Argand, with seven-inch chimney, or other approved burner. The price of gas is not to exceed 4s. 6d. per 1000 feet. The preamble of the Bill states that, according to estimates made, £45,000 will be required for water-works purposes, and £96,000 for gas-works purposes. In the body of the Bill, however, we see that power is sought to borrow £500,000 for water-works purposes. No specific sum is named for the gas-works, but it is sought to borrow £400,000 for the purposes of the Act, other than water. The debts of municipalities grow apace.

A CHRISTMAS APPEAL.—We have the pleasure of announcing the following contributions, in aid of the family of a gas and water works manager, referred to in previous numbers:—

Amount already acknowledged	£53	19	6
Liskeard	0	3	0
Mr. J. Wadeson	0	10	6
V. P. N. H.	0	2	6
Mr. H. Sainsbury	0	5	0
Mr. J. Hepworth	0	10	6
Mr. T. Stone	1	1	0

FIRE-BLOCKS OF TAN.—It is stated that a firm in Treves, Germany, manufacture fire-bricks of refuse tan, just as it is taken from the pits. They are made in a very simple manner, without special apparatus, and without being baked, and are said to almost equal the best stone coal in flame, duration, and heating power. They appear to be nothing more nor less than dry tan saturated with gas tar. They are very heavy, and when broken the fracture is a brilliant black. They burn at first with a brilliant flame, which gradually slackens, and at last they burn dead like coke.

ENTERTAINMENT OF THE EMPLOYES OF THE PARTICK, HILLHEAD, AND MARYHILL GAS COMPANY.—The fourth annual *soirée* of those employed in these gas-works was held last Friday night in the Burgh Hall, Hillhead—Provost Shaw, Maryhill, presiding. Among those present were—Provost Cowan, Hillhead; Bailies Mathieson and Duff, Hillhead; Rev. Mr. Moyes, Rev. G. M. Grant, Partick; Mr. Wm. Graham, secretary of the gas company; Mr. Hislop, manager; Mr. H. Crawford, Mr. Henderson, and a number of other gentlemen. Upwards of 250 were present, and after tea, the chairman delivered an interesting address on the progress of the company. He contrasted the present position of the burghs joined in this enterprise with that which they occupied several years ago. As an advice to the general public, he said that very frequently complaints were received by the officials as to the quality of the gas supplied by the company, but if the consumers would more frequently change their burners it would be seen that the gas was equal in illuminating power to what was represented by the manufacturers. An old burner did more to destroy the quality of the light than did the quality of the coals and supposed inefficiency of the plant of the works. A concert and an assembly followed.

A TREATISE ON THE SCIENCE AND PRACTICE OF THE MANUFACTURE AND DISTRIBUTION OF COAL GAS.

LXXXI.

The Exhaust Register.*

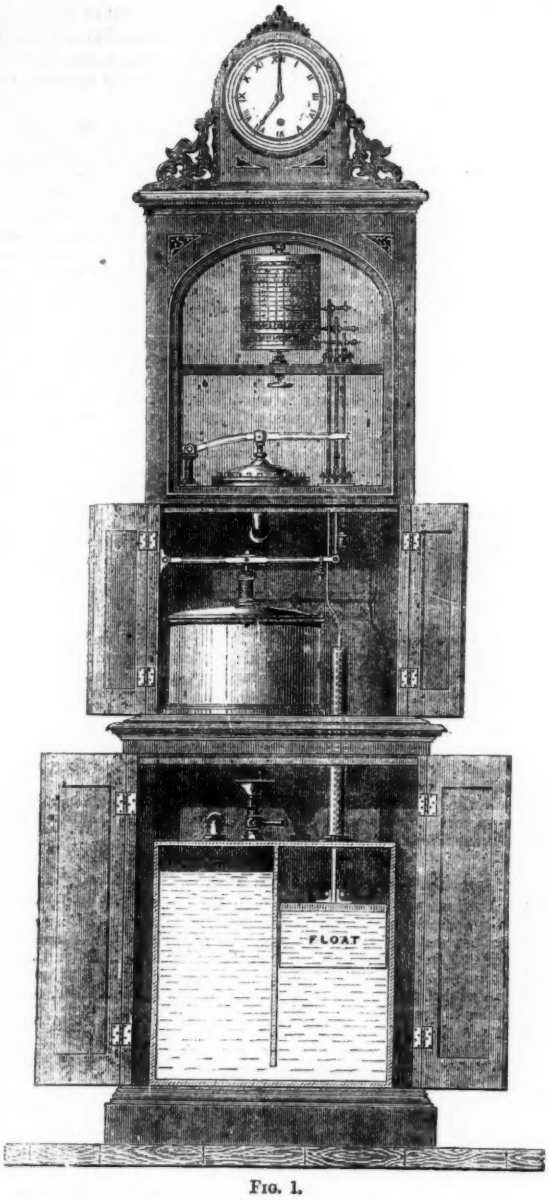

Fig. 1.

On the general adoption of clay retorts, about twenty-five years ago, the use of the exhauster, to prevent unnecessary loss by leakage, became indispensable. But the application of the instrument was often attended with prejudicial results, either arising from carelessness, want of knowledge, or, sometimes, through a spirit of rivalry which existed between the men in charge of the apparatus, who, desirous of showing a superior production of gas, pressed the instrument beyond the desired limits. From whatever cause, however, excessive exhaustion arose, it was attended with the same injurious effects, by combining a portion of the compound gases of the furnaces, or atmospheric air, with the gas in the process of manufacture—thus reducing its illuminating power in a remarkable degree. To counteract this evil, the exhaust register was adopted.

This instrument is very similar in all its details to the pressure register, the only difference being, that, whereas in the pressure register the point zero, when the holder is in equilibrium with the atmosphere, is at the bottom, in the exhaust register it is placed about midway on the table, all the lines above that point indicating *pressure*, whilst those below zero indicate *exhaust*. Hence, by this apparatus, a faithful record of the operations of the exhauster is obtained—a consideration of paramount importance, alike for the economical production of gas as well as to prevent its deterioration by any injurious admixture therewith.

It must not be forgotten, however, that automatic regulators, for controlling the exhauster, have been invented, which, as already stated, fulfil all the desired requirements, but as the operations of these regulators are liable to be tampered with by interested parties, the exhaust register becomes a desideratum. But as gas manufacture progressed, it was found desirable not only to record any irregularity in the action of the instrument in question, but also to give immediate notice whenever this occurred, so that the evil could be at once remedied. We believe that Mr. F. J. Evans was the first to appreciate the necessity for such an appliance, which resulted in the invention by him of a very ingenious apparatus, actuated by electricity, which, on any deviation from the proper degree of exhaustion occurring, gave due notice of the same, by sounding an alarum, the disagreeable noise of which was prolonged until the exhaust was properly adjusted.

An illustration of this apparatus would be of considerable interest, but we regret our inability, at present, to obtain a drawing, from which the engraving could be made. We hope to be able to supply it hereafter.

To Mr. W. Mann, the engineer of the late City of London Gas-Works, we are indebted for a very ingenious apparatus, immediately connected with the subject under consideration, but of a more comprehensive character; as, in addition to doing the duty of an exhaust register, the instrument referred to, indicates the time occupied in testing the gas, and acts as a check on the engine stokers, ensuring their regular attention to the height of the water in the boiler.

The apparatus, as represented in the drawing, fig. 1, is divided into three distinct compartments, the two lower ones being closed with wooden doors, the upper compartment having a glass door; the whole being surmounted by a timepiece. Similar to the pressure and exhaust registers, there is a revolving vertical drum with its

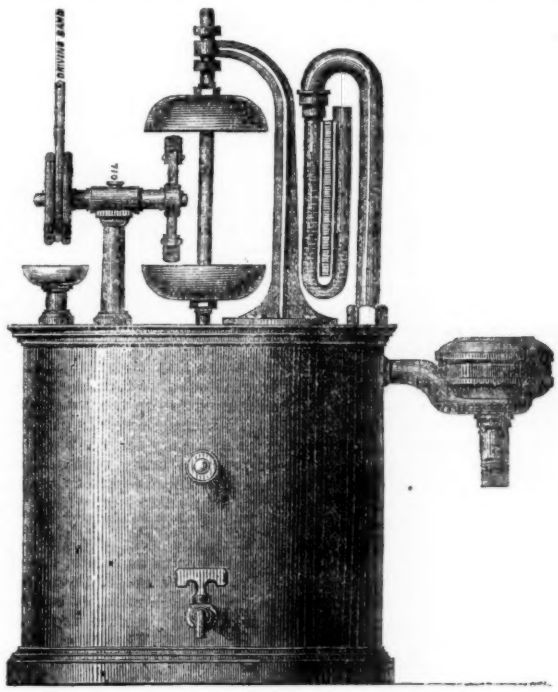

Fig. 2.

table, and there are three pencils (which may be of different colours), each of which fulfils a separate duty as hereafter explained.

The registration of the extent of exhaust is controlled in the lowest compartment. In this is a cistern (shown in section) divided into two, but connected together at the bottom. At the upper part of one of these compartments is a pipe in communication with the exhauster, whilst in the other compartment is a float with its rod passing through a tube and carrying the uppermost pencil. Hence, according to the degree of exhaust so will the float ascend or descend, and the same will be indicated on the table by its corresponding pencil.

In all well-conducted establishments, periodical and frequent testing of the gas, at least for sulphuretted hydrogen, is of the first importance; and, by the invention now described, Mr. Mann records when these operations are effected and their duration. This is accomplished by means of the apparatus in the central compartment, which consists of a cylindrical vessel containing a horizontal flexible diaphragm, similar to a dry governor, to which is connected a rod passing through the cover and acting on a lever, with its corresponding rod and recording pencil.

From the cylindrical vessel, there is a small pipe leading to the purifying-house (the distance from which is no object), and connected to a four-way test-cock on the main outlet of the purifiers. When the cock is not open for testing, the plug is in the position for allowing the pressure of the gas at this point, through the medium of the pipe, to keep up the diaphragm, and also the pencil; but as soon as the cock is turned on for testing, a small orifice is at the same time opened, which allows the pressure in the small pipe to escape in about one minute. During this time the pencil is coming down, and making

* An unfortunate error occurred in the last chapter of this series of papers. The first table on page 121 was stated to be a "Table of the Pressure per Square Foot, corresponding with Various Columns of Water, expressed in *Tenths* of an Inch." It should have been, as is apparent from the table itself, *Twelfths* of an Inch. This correction must, of course, be applied to the remarks based upon the table in question.—Ed. J.G.L.

its mark on the hour line or half-hour line, as the case may be; thereby, not only registering the time the test was taken, but also its duration. The pencil falls about half an inch in one minute.

The uppermost chamber is intended for the purpose of keeping check on the engine stoker, and to assure the proper supply of water to the boiler. For this purpose the stoker is required to blow off steam from a gauge-cock attached to the boiler, every half hour, it being assumed that this would be sufficient guarantee for the proper fufilment of the duty. This operation, like the others, is of great simplicity. Within the domed-shaped vessel is an india-rubber diaphragm, the chamber beneath this being connected by a pipe with the gauge-cock. The pipe and chamber are filled with water under pressure, which causes the diaphragm to press against the dome of the vessel, but in the act of shutting off a tap, to enable the attendant to blow off at the gauge, the diaphragm, on being relieved of the pressure, descends, giving motion to the lever, and so indicating on the table the precise moment of the operation.

The apparatus is very effective, and capable of more general application, and is another important contribution of its inventor towards the progress of the manufacture of gas.

By another simple contrivance (Fig. 2, page 157) Mr. Mann gives a continued alarm, whenever the exhaust is excessive or deficient. This is accomplished by a small governor having its central rod protruding through the centre of its cover, and on this rod are fixed two bells, situated a short distance from each other, midway between which revolve two small arms, being, indeed, the hammers for striking the bells. These hammers are attached to an axle, revolving on a standard, and driven continuously by a small gut band. So long as the exhaust is at the desired degree, the hammers revolve silently, but immediately an excess or diminution of exhaust occurs, one of the two bells is brought in contact with the revolving hammers, and a continued ringing is produced, until the exhaust is properly adjusted.

In constructing the pressure, or exhaust register, the area of its bell or holder is the first consideration. This we will assume to be 13½ inches in diameter, corresponding with an area of one square foot, which assumption facilitates the explanation of the apparatus. We will also assume the holder and float, when at their greatest elevation, to weigh 10·4 lbs., and to rise, when in operation, to a height of 12 inches, the length of bell and height of water-line being 12½ inches.

As already stated, when the apparatus is ready for action, the holder at the bottom is just buoyed or lifted from its bearing, being in equilibrium with the atmosphere. But on gas being admitted, it will ascend in proportion to the degree of pressnre, and in ascending, the float will gradually rise out of the water, and, accordingly, lose its buoyancy, the effect of this being equivalent to weighting the holder in proportion to the capacity of the float emerging from the water. In addition to this, the difference of the weight of the sides of the holder and the float, when immersed or emerged, has also to be taken into consideration.

The weight of the holder and float, when at their greatest height, being 10·4 lbs., this, for the area given, is equal to 2 inches pressure, which degree of pressure would be required to lift the vessel to its full height. Hence, a ruled table of 12 inches long, divided by 21 equidistant horizontal lines, would be necessary for an instrument like that in question, each tenth of pressure being represented on the scale of about half an inch in length. The weight of the holder we find corresponds with the sixth part of a cubic foot, which gives the capacity of the float, or about 5½ inches in diameter.

By increasing the diameter of the float, and weighting the holder in such a manner that the floating point remains as before, the scale can be correspondingly increased. As usually made, these instruments indicate 30 or 36 tenths of an inch, which must, of course, be governed by a consideration of the maximum pressure required to supply the district.

In the exhaust register, the area of the float is increased, so that the floating point of the holder is considerably higher than in the other apparatus. Thus, if the area of the float be the fourth part of a square foot—*i.e.*, 7 inches in diameter—the weight of the holder being as before, then the floating point, corresponding with zero, would be about the centre, and the holder, in ascending, would indicate pressure, and, in descending, exhaust.

(To be continued.)

Correspondence.

THE DEPOSIT OF CARBON IN RETORTS.

Sir,—I should like, with your permission, to say a few words in reply to the various letters which have appeared in the Journal, questioning my views with regard to the deposit of carbon in retorts.

I am not at all surprised that adverse views are held by some; but I do not think that what they have said has in any way disproved my statements.

In my former letter I confined my remarks to the consideration of clay retorts, but it has been said that carbon is formed as rapidly in iron as in clay retorts, and that it cannot be attributed to transfusion of gases. Why not? I admit that iron, at a temperature of 60° Fahr., will not allow of the rapid passage of gas through its pores; but it does not appear to me unreasonable to suppose that iron, heated to 1800° Fahr., as is the case with a retort, would have a different effect, as it is then in a different condition. At a low heat the amount of deposit is very small; but it is well known that a high heat is favourable to dialysis.

"Nemo" thinks that because the carbon deposit increases and grows upon itself, dialysis has nothing to do with it, the carbon being void of porosity. I should like to ask him if he knows of *any* substance which is not more or less porous.

I have just broken in two a piece of carbon, about 1½ inch thick, from a retort, and I find that that portion of it which was nearest the surface of the retort is much denser than the portion deposited at a later period; and this seems to point to the conclusion that the gas, in passing through it, deposits particles of carbon in the pores, and it is evident that the part nearest the surface of the retort would be more dense, as the greater quantity of gas passes through it. It will be seen, on breaking a piece of a clay retort that has been in use a considerable time, that its pores are filled with carbon, and if it is not caused by the passage of gas through it, I do not see how it is to be accounted for, as we cannot attribute it to high heat alone.

It has been said by some of your correspondents, that my statements are likely to mislead. I regret having made them if they have had that effect; my sole object was to have the opinions of others, and to get at the truth of the matter. I am much obliged to those gentlemen who have already given us the benefit of their judgment, and I hope if any one does not quite see the matter in the same light that I do, that he will point out where I am wrong, as I have no wish to be the means of propagating an error.

Northampton Gas Company, Jan. 28, 1876. Joseph Tysoe.

Sir,—I have perused the correspondence which has appeared on the deposit of carbon, with deep interest. Having experienced great inconvenience and loss from this cause, I have been induced to give it close attention, and perhaps the results may not be uninteresting to your numerous readers. I have found by experience that the nearer retorts are kept to a white heat, the greater the deposit of carbon, and as the back part of retorts is always the hottest, carbon is there deposited first. In the second place, the deposit in the end of the retort may be greatly facilitated by improper charging. If stokers will well fill the end of the retort, gradually diminishing the charge to the mouth, thereby preventing any obstruction to the forward flow of gas to the ascension-pipe, it will be found to lessen considerably the deposit; but when the middle of the retort is filled, and the end where the greatest heat is, is kept full of gas, then it is that decomposition takes place, and a deposit is formed. In the third place, I find, by experience, in works where there is no exhauster, that the greater the pressure thrown by the hydraulic seal on the retort, the greater will be the deposit of carbon.

I quite endorse the sentiments of Mr. W. D. Cliff, in respect to the advantages and true economy of the best quality retorts, as low quality retorts are more porous, and, consequently, more liable to a deposit of carbon.

W. L. C.

GOVERNORS.

Sir,—In your issue of the 18th of January, p. 83, under the head "Governors," I find this statement—viz.: "That any change in the inlet pressure causes (while the governor is really in effective action) a variation in the delivery or outlet pressure, to the extent due to the variation of the operating force of the gas on the cone base." Now, does not this statement contain a fallacy? I consider the downward pressure on the sides of the cone exactly equal to the upward pressure on its base, and that, therefore, no change of pressure on any part of the cone can affect the action of the governor.

I should be glad of the opinion of any of your *mathematical* gas engineering correspondents on the subject.

Gas-Works, Kingsbridge. W. Jarvis.

EXHAUSTERS.

Sir,—At these works we have experience of working both, without and with an exhauster. Taking an average of two years before we had the exhauster, and the two years since, I find that with the exhauster we have made 800 feet of gas per ton of coal more than before, and all our working expenses are greatly reduced—one reason being that we make considerably more gas per ton of coal than formerly. I, therefore, consider an exhauster of great utility.

Queenstown Gas-Works, Jan. 22, 1876. Andrew Donaldson.

PHOTOMETRY.

Sir,—As an old gas engineer, I should like to suggest to my younger brethren the possibility of obtaining a really good reliable photometer from Mr. Crookes's "Radiometer," one of which was exhibited at the *conversazione* of our Midland Institute, last evening—a light frame of wire suspended in a vacuum, and caused to revolve by the *mechanical* action of light alone, *the speed depending on the intensity* of the light.

William Richardson,

Birmingham, Jan. 14, 1876. Gas and Hydraulic Engineer.

Parliamentary Intelligence.

GAS AND WATER BILLS, 1876.

Monday, Jan. 24.

The Examiners declared the Standing Orders to have been complied with in the cases of the following unopposed petitions for Private Bills:—Huddersfield Water and Improvement, Braceborough Water, Blackrod Gas.

Tuesday, Jan. 25.

The Littlehampton Water Bill passed Standing Orders.

Wednesday, Jan. 26.

The Examiners certified for due compliance with the Standing Orders in the following unopposed cases:—Spennymoor and Tudhoe Gas, North-East Worcestershire Water, Leicester Improvement, Dewsbury and Heckmondwike Water.

Thursday, Jan. 27.

The following unopposed petitions for bills passed Standing Orders:—Colney Hatch Gas, Derby Gas, Llandudo Water and Gas, Leigh and Hindley Local Board, Oldbury Local Board of Health, Blackrod Local Board, Newcastle and Gateshead Water.

Friday, Jan. 28.

The requisite proofs of compliance with the Standing Orders were given in the following unopposed cases:—Chesterfield Water and Gas, Southampton Gaslight and Coke, Norwich (City) Water, Campbeltown Burgh and Harbour, Edinburgh and District Water, Horncastle Gas, Smethwick Local Board, Bridgewater Water, York New Water, Redcar and Coatham Gas.

The memorial against the Rosstrevor Improvement Bill was withdrawn, and the Standing Orders declared complied with.

Legal Intelligence.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

TUESDAY, JAN. 18.

(*Before Vice-Chancellor* BACON.)

PATTERSON *v.* THE GASLIGHT AND COKE COMPANY.

Sir HENRY JAMES, resuming his argument, reminded the court of the point to which he was addressing himself on the previous Saturday, and proceeded to say he would endeavour to deal with the case which was set up by the plaintiff in answer to the direct and strong testimony of the defendants. As far as he could judge what the rebutting case was, it appeared to be based upon two grounds. First, that the statement, which was made affirmatively, could not be true, because the results showed that that which was contemplated as being the effect of the use of the patent—namely, the reduction of the amount of impurity in gas—did not take place, and consequently the statement was incorrect. There seemed to be a second ground upon which answer was made—namely, that inasmuch as the main principle of the patent was a more ready change of the earlier purifiers—namely, as soon as carbonic acid was shown, and therefore their employment for a shorter period than had formerly been the case, according to the records which were kept, it was shown that that shorter period of use was not carried into effect, and, therefore, that the plaintiff's principle was not applied. That that was the answer was to be drawn from the address of the plaintiff's counsel, and from the statements made by the plaintiff himself. The plaintiff said he looked at the workings of the purifiers, and he knew that was not so. Asked whether he believed Dr. Letheby, he could only say it was "totally irreconcilable" with the results which had been arrived at. It came to this, that assuming for a moment the plaintiff's data to be correct, he said, inasmuch as his patent on being employed did not produce beneficial results in the first instance—*i.e.*, as advantageous as were afterwards obtained—he would look to the results in the after time, and say he established by the fact of those more beneficial results at a later period that his patent was valuable by those more beneficial results. The affidavit would say how far it would adopt the plaintiff's theory, whether the fact of more beneficial results being produced afterwards established that, until those beneficial results were obtained, there was no employment of the plaintiff's patent. In the re-examination of Mr. Evans, attention was called to what had been the results obtained at Bow in the month of November, 1871, before any question arose. The court would also bear in mind the evidence of Mr. Harris as to the mode which was pursued of working at Bow. He reminded the court that the plaintiff's case was that a small amount of impurity in relation to the sulphur compounds could be obtained only by his process. His case was, too, that at Bow there was no employment of anything approaching to the principle contained in his alleged patent, and that he had discovered the only mode of doing it. From the 1st of November, down to the 17th of that month, the total impurity, according to Mr. Evans, amounted to 207·5, the average being 14·8 grains, a smaller amount of impurity than at Beckton, at the time when the plaintiff set up infringement of his patent. If the plaintiff's case were correct, that by the employment of his patent alone the small amount of impurity could be obtained, he (the learned counsel) would argue in the circle which the plaintiff himself had drawn, which was that the defendants did employ his process in the autumn of 1871. If that were not accepted, then, at all events, it established that the small amount of impurity, or the large amount of impurity, would not prove the affirmative of the plaintiff's assumed fact, nor yet negative. Dealing with the first head of the rebutting case of the plaintiff—namely, that in February and March there were large returns of impurity, and therefore his patent at that time was not employed, he would show that the fact that there was comparatively a large amount of impurity, was perfectly consistent with the employment of the process which Mr. Trewby at that time regarded as a valuable one towards the end of diminishing the impurity, and that the fact of the maintenance of a higher state of impurity was due to causes which would regulate its amounts, notwithstanding the employment of the alleged patent. It was not alone by the employment of the plaintiff's patent that they could diminish impurity, unless all other conditions were equal in the mode of carrying it out. If it could be shown that, when it was first employed there in the month of February, according to the plaintiff's view, and sufficient cause shown why the results should not be obtained, notwithstanding the employment of the process, then the whole argument, which was endeavoured to be based upon the now beneficial result, remained without foundation, and, of course, fell to the ground. What would be expected when a new method was carried into effect? Not immediate, but gradual improvement. If the vessels that were employed for carrying that improvement into effect were deficient, so that the action of the lime upon the gas was not satisfactory, if the gas was passed into those vessels under the circumstances and conditions causing the effect of the lime upon the gas not to be equal with that which was afterwards obtained, then, of course, they could not arrive at such satisfactory results as would be obtained by the more complete use of the process. He would show that every one of those conditions of things did exist, to which any one would look for the reason why a satisfactory result was not obtained, and to which the plaintiff himself had made reference, and which, in fact, he had given as a cause why the result had not been obtained. Mr. Trewby's evidence was clear upon this point, showing the action of the condensers and scrubbers, and the temperature at Beckton, as fully accounting for the large amount of impurity contained in the gas whilst the works were incomplete and inefficient. The statements of the plaintiff himself were quite confirmatory of this in the report of the 31st of January, 1872, to the Board of Trade, which report dealt with the methods of purification; and under the head of carbonic acid stated that the inadequacy of the condensing apparatus had hitherto impaired the action of the scrubbers, and this in turn had impaired, and almost neutralized, the action of the lime in the purifiers upon the sulphur. If that were so, then the plaintiff placed before the court the key to that which was now said to be a mystery, unless his patent were employed. What course did the plaintiff take? In order to meet the difficulty that his own report placed him in, because it was destructive of his own contention, he went through the humiliating process of asking the court to believe, when he was in the witness-box, that the statement made in the report was not true, and that it was not a correct representation of the state of the works at Beckton. The plaintiff, with a total want of foundation for his argument and contention, now endeavoured to induce the court to believe that that which he stated in the performance of his duty was untrue; not because he was deceived by those on the spot, nor because he was wrong in his observation, but, taking the testings, he said the results were not such as would be obtained, and, therefore, the statement could not be correct. The plaintiff did not attempt to say that the statement was true. Then, was it reasonable to suppose that the plaintiff's own statement was correct? The report was dated the 31st of January, and must have been prepared from data obtained, and observations made, at an earlier date. At the time when they came to the conclusion that at Bow the temperature was 65 degrees, as against 100, and at the very time they were tracing to this increased temperature the cause of the impurity, what was the condition of things at Bow? At Bow the impurity was 14·8, as against 40 at Beckton, so that the referees, and the plaintiff conspicuously, traced the cause why the large amount of impurity existed. Those causes existed when the report was written on the 31st of January; those defects were not remedied, at any rate, during the months of February and March; better condensers were not employed, and all the evil effects then existed. Step by step they showed that the plaintiff attributed the result of high impurity to causes, existing at the date of the report, which were not removed, and they were able to show, from the causes which the plaintiff pointed out, the reason of the effect produced; and yet it was upon that effect alone, and the results, that the plaintiff relied when asking the court to believe the testimony to be untrue. But there were other defects which, it must be admitted, existed at the time of the employment of the new method by Mr. Trewby in February, which would account for the maintenance of the high impurities. Those defects were in a latter portion of the process—viz., in the purifiers themselves. They existed from the distortion of the purifier, and from the "sagging," as it had been termed. Speaking of it gently, the result would seem to be that a certain portion of the gas would not come in contact with the lime at all, but would be able to escape through the purifier untouching the lime, and, therefore, without any absorbent qualities of the lime being employed, and the gas would pass through the test, and out of the purifiers, as impure as when it entered. That those defects existed was, of course, a question of fact, and a question of very plain amount of observation to be employed in relation to that fact. He was weary of thinking that, in a case of that nature, it was necessary to place before the court the evidence, as if he were dealing with a charge of perjury; and, therefore, he would not argue upon the credibility of such gentlemen as Mr. Evans and Mr. Trewby. If they were speaking untruths, they were doing it in the face of an amount of power of detection and contradiction. No doubt there was a trifling variation in their evidence, as would often occur when witnesses were speaking the truth, but the variation was entirely immaterial. Mr. Evans, in his first affidavit, stated that all the alterations and additions to the works were made by Mr. Trewby in or about March, 1872, when it was discovered that the lime purifiers made of wrought iron had become more or less distorted, under the great pressure, so as to leave more or less space between the lime and the sides of the vessel, and that through this space the gas found its way from the inlet to the outlet. This defect was ultimately remedied about May, 1872. Such defects existed more or less throughout 1871, and contributed sensibly to prevent the purifying in that year from being complete. He repeatedly stated to the plaintiff in the year 1871, and in the early part of 1872, that there would be a great improvement in the purification, when the Beckton works were completed; and that when such works were completed, the sulphur impurity would be reduced to the lowest possible amount. Mr. Evans being challenged upon that statement when in the box, said he ascribed the distortion of the purifier to the fact of the support being insufficient in the centre. This fact was known to the men on the works, and the contractor, who supplied the timber, had to replace them. The fault was his (Mr. Evans's) in not making them strong enough. The defect existed in the year 1871, and contributed sensibly to prevent the purifier in that year from being complete; there was no doubt the quantity of lime used, the increased make of gas, and the works not being sufficiently put forward, were what made the increase. There was no doubt that from the very first it occurred to a certain extent. Mr. Trewby in his evidence confirmed this view; for he also stated that the impurity was caused by the sagging, and that it was afterwards remedied. He trusted that he had satisfied his lordship's mind that the defect of insufficient support did exist. As the plaintiff was placing his case before the court by way of reply to that evidence, it did appear to the defendants worthy of consideration whether they could not trace the causes on which he was relying to other defects, that they had not far to go to find them, for they were set out in the document before the court. The plaintiff endeavoured to solve the cause why a large and unexpected amount of impurity existed in the gas produced at Beckton; he traced them not to the non-employment of his own method, but to those inherent defects which he knew did not exist on other works; he traced them to the defects in the condensers and in the temperature, and on the 31st of January he himself said it was to those causes he attributed the large amount of impurity, and that when they were removed he should anticipate a less amount of impurity; and his anticipations had been realized. The second head of the case which had been employed to destroy the defendants case was somewhat shaped in this fashion: You told me you employed, before the 19th of February, a different method; but I now refer to new records which cannot deceive me, and I refer to records of the length of time during which the purifiers were employed during February and March. The inference which the plaintiff sought to draw from the figures contained in the table were founded on a fallacy, and from a little continuation of that ignorance which he possessed up to Christmas, 1871. The table set out the dates when the purifier was put into work, when it became foul, when it ceased to work, and then came the deduction of the number of days it was working after it was foul. The plaintiff fashioned his argument somewhat in this way, he said: your lime becomes foul, say, two days after it was employed, and directly it becomes foul the sulphuretted hydrogen was cast off from it, and it then proceeded to absorb only carbonic acid, and became converted into carbonate of lime; if you were carrying out my process, you ought, at the time of its becoming foul, to have discontinued the use of the purifier. That was a fallacy, not so much in theory as in practice. He would not, however, press that point too strongly against the plaintiff, because chemists very often found, as stated by Dr. Odling in his evidence, that practice was much stronger than theory. Then the defendant had to meet the difficulty that there was no time mentioned, or period fixed, when it was said the alleged infringement commenced. The plaintiff's case was so weak, that he had to draw the inference of infringement from the lessening of impurity; and the only way in which the date was at all fixed was by the statement of the plaintiff, that he found a total change made from the beginning of April, 1872, in the manner and form of recording the working of the purifiers at Beckton. Taking the month of June, it would be seen that purifier No. 1 was not taken out till after it had become foul from sulphuretted hydrogen 17 days; No. 3, 20 days; No. 2, 15 days; and No. 4, 17 days.

Mr. KAY said the table had not been proved.

Sir HENRY JAMES said it was proved by the affidavit of Mr. Trewby, but that gentleman could be put into the box, if necessary, to prove it. If the defendants had shown that the decrease of impurity was not due to the change of working the purifiers, and that there was no difference in the working between June and February and March, that disposed of the plaintiff's case upon that point. The defendants had endeavoured, by evidence at their command, to show that there had been a change of working at the Beckton works as early as the month of February, and the letter written by Dr. Odling, about the 28th of March, supported that statement. With regard to the point whether the plaintiff in any sense could be regarded as the real inventor of the process, he would remind his lordship that Mr. Patterson was, at that time, a paid and public servant, with particular duties to perform, and particular objects to accomplish; he was not only paid to perform duties, such as he chose to perform, but they were definite duties. He had power to search and discover, and could compel information to be given; he was sent with compulsory power over different gas-works to observe what they were doing, to enter the works by night and day, to discover all their secrets, if they had any, by compulsorily entering their premises, and extracting information. Having obtained information in that way, he had, as he himself stated in his report, certain duties to perform; but the information thus obtained was condensed by him into a patent. Would it not have been startling if it had been known that at the date of the report, the 31st of January, it being the duty of Mr. Patterson to make the discovery, for which purpose he had been armed with compulsory powers, he knowing it to be his duty to faithfully place it before the public, in order that the public might carry it into effect—he contemplated obtaining a

patent, in order to prevent the public carrying the discovery into effect without his permission. The report was a trap to the public, because it told them to use the mode; and although it was his duty to inform the public, he kept back from them the information, that if they used it, it must be either on the payment of royalties, or being subject to an action for infringement. He would not further trouble his lordship with any remarks, but would leave his learned friend who followed to deal with the points of law.

Mr. *Trewby*, recalled and cross-examined by Mr. KAY, explained certain entries in the records of workings of purifiers at Beckton, more especially with regard to their order. He said: The first was sometimes changed and put on clean, and sometimes the last. The first time the testings for carbonic acid were recorded was the 1st of May. The reason was that we did not think it important to put it down, although it was always reported verbally. We began to put it down on the 1st of May to make the record more accurate, that we might have a record before us to show how long the principles took before they showed carbonic acid. It might have been equally important to do it before the 1st of May, but I knew it. I had not given instructions for it before that time. I cannot tell my reasons now, but, as a matter of fact, I knew it from day to day. I do not think I gave instructions that the record should be kept in red ink; but it appears as a record in red ink from that time forward. I altered the form of entries on the 1st of April to see at a glance the order in which the purifiers were worked. I thought the way the purifiers were entered on the 1st of April was a better way than had been in use previously. As far as I can remember now, that was the only reason. The first and second of the series were worked as carbonic purifiers. We tested for carbonic acid in those purifiers, and when one showed what we tested for, we took out the lime and put it on in the same order in some cases. We never allowed carbonic acid to enter the third and fourth purifiers of the series. We altered the order from time to time until February 18 and the 1st of May, putting them on clean in different order. The statement in my affidavit is not meant to differ from the record. The contract for the carbonate purifiers was made in December, 1872, and they were put up in the latter end of 1873.

Re-examined by Mr. DAVEY: On the 20th of February there were four purifiers at work at once, and previous to that time only three. That was continued down to April. When we had the four purifiers on, I worked the first two for carbonic acid, and did not allow any carbonic acid to enter the third and fourth purifiers, my object being to keep the third and fourth always in a state of sulphide. I applied the carbonic acid test to the first, and if carbonic acid were shown, we in some cases took it off immediately; but sometimes let it go on some time longer, taking care that no carbonic acid entered the third and fourth purifiers. We had a sulphur test on the outlet of the last purifier, and when we thought the last purifier would not take up any more sulphur, we emptied it, and recharged it with fresh lime. On some day in April we had only three at work at once. We then tested the first purifier for carbonic acid, and when it showed carbonic acid it was thrown out, and a clean one put in first. I believe that was continued up to the 12th of May. I have not the slightest doubt we always tested the first purifier for carbonic acid. The two outdoor purifiers we are now using were not in use in 1872, and the gas passed direct from the scrubbers into the houses. I am quite positive as to that.

Mr. DAVEY, Q.C., following Mr. Southgate and Sir H. James for the defendants, said he was exceedingly glad the court had had the opportunity of hearing Mr. Trewby's explanation. Upon that he should ask his lordship whether he had the faintest doubt that, from the 18th, 19th, or 20th of February continuously, up to the 12th of May, and even thereafter, Mr. Trewby had been working the purifiers in the way he described. Whether he used four purifiers in two sets, the first being carbonate purifiers, and the last two sulphur purifiers, or whether he afterwards found it more convenient to use them in a set of three, using the first only as a carbonate purifier, he had always used the test for carbonic acid, and regulated the use of his purifiers in accordance with the carbonic acid tests. If that were so—if from a date three weeks anterior to the plaintiff's patent, continuously up to the present time, with a slight modification, Mr. Trewby had worked his purifiers in that manner, was not that a prior user of the plaintiff's patent? His lordship could not conceive that Mr. Trewby would create evidence before the date of the patent, by writing the letters to which attention had been directed.

The VICE-CHANCELLOR said the beginning of the two purifiers out of the house was now said to be in 1873.

Mr. DAVEY: No doubt, when the answer to the original bill was put in, they were not in use, and that was filed in August, 1873. The part of the case to which, in the division of labour, he proposed to direct the observations which he asked his lordship to have the patience to listen to was as to the validity of the patent as disclosed upon the specification itself. He should ask the court to consider the patent as disclosed in the specification, having regard to the facts, scientific and otherwise, which he took to be now either admitted as common ground on both sides, or sufficiently proved. He would shortly enumerate the facts which he considered to be material. First, he took it to be abundantly proved, and not denied, that long before the date of the letters patent lime had been used for the purification of coal gas. Mr. Evans told him that it was so even before 1850, but that in 1850, owing to the discovery of the renovation of oxide of iron, that was substituted for lime in towns. But before 1850, and from that time since, in all country works lime had been continuously used. The second fact which he should assume in his argument was that sulphide of calcium was the form in which the lime would operate upon sulphur compounds; that lime, until it was saturated by sulphuretted hydrogen, would not operate upon sulphur compounds, and had no effect upon them. That was now admitted by the affidavits in reply and at the bar to have been known to chemists long before the date of the letters patent. More than that, it had been proved, notwithstanding the statements which had been made in the plaintiff's affidavits, that it was practically recognized as an efficient instrument for taking out the sulphur impurities from gas. Dr. Letheby in his affidavit referred to a lecture which he delivered or a paper that he wrote in the year 1870, on the subject of the Bow works, in which he described, two years before the patent was taken out, the system pursued at the Bow works' and proceeded to describe the chemical principles upon which the system was based, by saying that what took place was very intelligible, for the sulphuretted hydrogen by combination with the lime formed sulphide of calcium, which, in its turn, was broken up by the carbonic acid, and the sulphuretted hydrogen was expelled. Therefore, in 1870, Dr. Letheby published a description of the scientific principle upon which that system was based. In considering the first head of the patent it was a fact of cardinal moment that the plaintiff said he was not aware that that was known to chemists. The third fact which he took to be common ground was, that when gas, charged with sulphuretted hydrogen and carbonic acid, entered clean lime, the action which took place was that the lime absorbed up to the point of saturation the sulphuretted hydrogen and carbonic acid. But the carbonic acid having greater affinity for lime than sulphuretted hydrogen, if the lime was not passed too quickly through the gas, the carbonic acid taken up in the first instance drove the sulphuretted hydrogen before it, so that at the point of saturation, it was charged in this way, the lower parts of the trays of lime were carbonate of lime, or substantially so, and the upper parts were sulphide of calcium. That was how the two things were arranged at the point of saturation. In other words, the sulphuretted hydrogen was always the forerunner of the carbonic acid, subject to the remark that the gas must not be passed too quickly through the lime. The fourth point, which he should assume as proved was, that there were three modes which, previously to the plaintiff's letters patent, existed of working the lime purifiers for the purpose of removing sulphur compounds, but all based upon the same chemical principle. The three modes were, first, testing for sulphuretted hydrogen at the last of the series, and drawing out the first directly the testings showed sulphuretted hydrogen. Another mode which was in use was also to test for sulphuretted hydrogen, not testing at the last purifier of the series, but at the last but one, and drawing out the first purifier the moment the second showed sulphuretted hydrogen. The third mode was the mode which, from the evidence, appeared to have been in use at Bow, of which the court had heard so much. That was to use a series of three purifiers instead of four, two in and one out, and to test directly for the sulphur at the exit of the first purifier, between the first and second, and then to test again at the second purifier. Another point which he took to be proved if not admitted was that the carbonic acid and the sulphuretted hydrogen existed in crude gas in any variety of proportions. During the experimental period at Beckton the proportions were three of carbonic acid and one of sulphuretted hydrogen, whereas Dr. Letheby stated that the usual proportions were rather the reverse. No doubt the proportions at Beckton were unusually high. The variety in the proportions in which carbonic acid and sulphuretted hydrogen existed in the crude gas depended upon the quality of the coal, and partly upon the efficient action of the scrubbers, and indirectly on the condensers. Therefore, any argument based upon the proportion of sulphuretted hydrogen and carbonic acid existing in the gas, as found at Beckton, were not worthy of much consideration, because the evidence showed that the proportions varied to an almost infinite extent. He thought he should be able to show that a great deal of the argument of the plaintiff's counsel was based upon the fallacy that the unusually high proportion which was found at Beckton was the normal condition. Another point was, that the evidence showed there was no process at present known which would remove all the sulphur compounds, and that was very material in considering the point by which they endeavoured to show Mr. Harris's ignorance, because he said he could not completely remove them. Indeed, the evidence proved that all the sulphur compounds were not yet formulated. Every one of the modes of purification by means of lime were covered by, and comprised in, the first head of the plaintiff's patent. The first heads of the patent, and of the claim, were for sulphide of calcium in separate purifiers. What the plaintiff claimed as novel and original, and as his invention, was the passing a stream of gas over sulphide of calcium in a separate purifier, or several purifiers. The plaintiff's counsel asked the court to hold that the first head of invention, and first claim, were for the use of sulphide of calcium for purifying gas when in a particular condition, that particular condition being the taking out of the carbonic acid and the sulphuretted hydrogen—in fact, to treat the first head of the patent as for purifying gas, when cleansed from carbonic acid and sulphuretted hydrogen, or as one branch of the decarbonate process. The construction which he (the learned counsel) asked the court to put upon it was, that it was for passing a stream of gas over sulphide of calcium contained in a purifier, and that the patentee had carefully avoided saying that it was necessary that the carbonic acid and the sulphuretted hydrogen should be eliminated from the gas before it was passed into the sulphide of calcium purifier. The patentee expressly stated it was not indispensable that the whole of the carbonic acid or sulphuretted hydrogen should have been eliminated. His claim was, in truth, for the employment of sulphide of calcium in a separate purifier or purifiers, and that was what he said he considered to be novel and original in his invention. If that were so, in the first place apply the well known legal principles applicable to patents. Was not a claim for sulphide of calcium used in a separate purifiers too wide? Did it not claim all applications of sulphide of calcium whatever? It would cover wherever sulphide of calcium was employed in separate purifiers; there being no novelty, there was no right to a monopoly. There was no right to the employment of sulphide of calcium, because that had long been employed to purify gas. There was no right to the employment of a separate purifier, because no kind of purifier, and no improvement in the purifiers at present in use, was suggested. So far as regarded the separate purifiers, whatever meaning was to be attached to it, it could only be that at starting, you were to have unmixed sulphide of calcium in the purifier. Were there any means, or was any process pointed out under the first head? It was nothing more than this—a purifier was used containing so-and-so; the plaintiff pointed out neither any particular kind of purifier or apparatus, but a general principle—that a purifier with sulphide of calcium would take out sulphur compounds if a stream of gas were passed over, and that it would be longer efficient the less carbonic acid and sulphuretted hydrogen were allowed to remain in it. Mr. Kirkham's mode was to test for sulphuretted hydrogen at the outlet of the last purifier.

The VICE-CHANCELLOR said that, according to Act of Parliament, no gas could be supplied to the public containing sulphuretted hydrogen; and, therefore, it was necessary to test for that before the gas passed into the mains.

(*To be continued.*)

COMMON PLEAS DIVISION.—WEDNESDAY, JAN. 26.

(*Sittings in Banco, before Lord Chief Justice* COLERIDGE, *Justice* DENMAN, *and Justice* LINDLEY.)

CORRIE *v.* MAYO.

This was an action tried before Jusice Quain during the present sittings, when a verdict was found for the defendant.

The SOLICITOR-GENERAL, in moving for a rule for a new trial, said the action was brought upon an agreement by which the defendant leased a house near Guildford to the plaintiff; and the sole term of the agreement which raised any question was, that the defendant should do all necessary work and things to secure a sufficient supply of water to the premises. The plaintiff took possession of the house in November, 1873, and soon after entry all his family and several of the servants were attacked with ulcerated sore throat, the symptoms of which in every case but one quickly disappeared as soon as the patients were removed from the house. For a long time it was not suspected that the water supply was the cause of the sickness, until, on a suggestion by a medical man, it was analysed by an eminent chemist, and reported to be utterly unfit for human consumption. A correspondence then followed between the plaintiff and defendant, and the defendant had some of the water analysed by another chemist, but with an even worse result. The defendant then took steps to remedy the mischief, and it was hoped he had succeeded, but the same symptoms broke out again, and with such severity that in the summer of 1875 the plaintiff and his family were obliged to leave the house. The defendant again set to work to remedy the mischief, and in a few months the water was pronounced to be pure and fit for consumption. The lease in the meantime had not expired, but there was no doubt that, at all events up to August, 1875, the plaintiff had suffered from the water, though the jury probably thought this cured by the subsequent remedy. The learned judge at the trial directed the jury as to the injury sustained; but they not only found a verdict for the defendant, but added, in the circumstances, the somewhat strange observation that, in their opinion, the action ought never to have been brought.

The COURT, after consulting the learned judge who tried the case, granted a rule.

SECOND SUB-DIVISIONAL COURT.—JAN. 25 AND 26.

(*Before Justice* GROVE *and a Common Jury.*)

PAYNE *v.* THE BRENTFORD GAS COMPANY.

Mr. TALFOURD SALTER, Q.C., and Mr. DARLING were the counsel for the plaintiff; Mr. MELLOR, Q.C., Mr. CHARLES HALL, and Mr. ERSKINE POLLOCK appeared for the defendants.

This action was brought to recover compensation for personal injuries caused by an explosion of gas, owing to the alleged defective state of the defendants pipes.

The plaintiff is a painter on glass, residing at Avenue Road, Acton. In February, 1874, he was going into a new house, situated exactly opposite his former residence. For some months previously he had complained to the gas company on various occasions that gas was escaping into his old house, but the company did not remedy the evil, although they sent men to examine the premises. On the evening of Friday, the 26th of February, he was working at some gas-fittings at his new house, the gas being turned off at the meter, which had been supplied by the defendants, but had been fitted by the plaintiff. About nine o'clock he went into the cellar, having in his hand a benzoline lamp. He then saw a flash in the corner where the service-pipe came in, and immediately afterwards the upper part of the cellar burst into flame, and the plaintiff was burned about his face and hands. The gas company was communicated with, and on Sunday morning an inspector came and tested the fittings, and found a small escape of gas at one of the joints of the meter. In the evening of the same day he came again, and, in the presence of a Mr. Parsons, again tested the meter, and also the aperture in the wall which admitted the service-pipe, at which point a flame immediately appeared. On the following morning the ground was opened, and the service-pipe was found to be broken. This was the account given by the witnesses for the plaintiff.

For the defendants it was contended that the accident was entirely owing to the bad fitting of the meter, and that the escape of gas complained of on former occasions could be traced to a similar cause. The defendants inspector also said he detected a serious leak on the top of the meter in the body of one of the pipes, and he explained the fact of the flame appearing, when a light was applied where the service-pipe entered, by referring it to the presence of gas in the crevices of the wall. He also deposed that the pipe, when the ground was opened on the following day, was accidentally broken by one of his workmen, and was previously in perfectly good condition.

The case occupied the whole of the two days, and in the end the jury, being unable to agree, were dischargod without a verdict.

ASTON PETTY SESSIONS.—Friday, Jan. 21.

(*Before Messrs.* Hill, Fowler, *and* Boughton.)

SUMMONS AGAINST THE BIRMINGHAM CORPORATION FOR WRONGFUL DISMISSAL OF A STOKER.

James Poole, a gas stoker, summoned the Corporation of Birmingham for £3 10s., which he claimed in lieu of 14 days notice.

Mr. E. J. Hayes, town-clerk, appeared on behalf of the Corporation.

Complainant stated that he had been employed at the Saltley Gas-Works as stoker from the 23rd of September until the previous Monday. He entered into an agreement to work for the gas company at 35s. a week, and to receive or give a fortnight's notice on leaving.

The agreement was produced, and, in reply to Mr. Hill, Mr. Hayes said he would admit it was binding on the Corporation.

Complainant said, on Monday last he went to the works, and was dismissed without any previous notice.

Cross-examined: He was dismissed by Mr. Shoolbridge. Mr. Jennings was foreman over him, and he ought to have obeyed any reasonable order of his. On Friday evening the cokes were turned out of the retorts, and allowed to accumulate on the floor. It was the "wheeler," Henry Horton's duty to remove the coke. Witness was neither drunk nor abusive on the Friday night. He did not say, "Come on, lads, and let us finish him;" nor did he push or threaten Mr. Jennings. On the Saturday night he did his work as usual. On the Monday morning he was not allowed to work, and Mr. Shoolbridge dismissed him.

Mr. Hayes said the defence was that complainant's behaviour on Friday night, the 14th of January, was so disgraceful that the manager was justified in instantly dismissing him.

Mr. *Jennings*, night foreman at the Saltley works, stated that, on the night of the 14th inst., he noticed that a large quantity of coke was left to accumulate near to the retort where Poole was employed. Poole could not go on with his work because of the heap of coke, and he agreed to remove it if witness would allow him "wheeler's" pay. Witness consented, and left complainant, expecting him to do the work; but on his returning to the place in a quarter of an hour the coke still remained near the retort, and had apparently not been touched, whilst Poole was gossiping with the other men. Witness asked him for an explanation, when he became very violent, and menaced and threatened witness with personal violence. He also incited the other men to assault him.

In answer to questions from the Bench, witness said he did not report complainant's conduct to the superintendent until Sunday night, and he had no power himself to suspend or dismiss him. Complainant was allowed to resume his work on the following night.

Mr. *Sidney Shoolbridge*, superintendent of the works, deposed to dismissing complainant on Monday morning last, on account of his gross misconduct on the Friday night, which was reported to him by Jennings. Witness stated that he informed him that, as he had broken his contract with the company by his disorderly and neglectful behaviour, he was not entitled to the 14 days notice.

Mr. Hill said the evidence proved that the superintendent was justified in dismissing the complainant in consequence of his conduct, providing that course had been adopted the same night; but the fact that complainant was allowed to resume his work on the Saturday night made it a condonation of the offence in law, and the dismissal on the Monday was therefore illegal.

An order was accordingly made for the amount claimed, with costs.

CAMBRIDGE COUNTY COURT.—Wednesday, Jan. 19.

(*Before Mr.* E. Beales, *Judge.*)

CAMBRIDGE WATER-WORKS COMPANY *v.* FULCHER.

In this case the defendant was summoned for payment of 7s. 6d., being the balance of a water-rate due from him to the company. The question in dispute between the parties was as to the powers of the water company to refuse laying on a service for the partial supply of water to any house. Defendant occupies a house in Earl Street, and has refused to pay the water-rate since he took possession in August, 1874, on the ground that the company had charged him for the water supplied to a water-closet, which he alleged was not supplied by them, but from a private pump in the house. He now paid £1 2s. 6d. into court, leaving 7s. 6d. as the amount in dispute.

Mr. Cockerell, for the company, contended that they could not undertake to give a partial supply of water to a house. If they did, it would be impossible for them to guard against being cheated. Householders who took but a partial supply could easily cheat the company, and he would show that in the present case, the pump was out of order at the time one of the company's officials inspected it, and it could not supply the water-closet.

Mr. *Tomlison*, engineer and manager to the water-works company, said he knew that 28, Earl Street, occupied by the defendant, was rated for water. Mr. Steinhilper was the previous tenant, and he paid water-rates, including an extra sum for a water-closet. When defendant succeeded Mr. Steinhilper, he did not inform him that he did not want water for the water-closet. The water was supplied to him as it had been to the previous tenant. The rates were charged on an *ad valorem* scale. One of the company's regulations provided "that no service will be laid on to any premises for a partial supply of water."

Mr. Cockerell submitted that that regulation involved a contract.

Witness, continuing, said, if a householder told them that he did not want water for his water-closet, the company would not let him have any at all for other purposes.

Mr. Ellison said he should contend that defendant did not receive a partial supply, but a full supply for all the purposes for which he required it.

Mr. *Dixon*, collector to the company, said, when he went round the first quarter after defendant became tenant of the house, defendant told him he would not pay the water-rate unless a certain portion was deducted in respect to the water-closet.

Thomas Oliver, another of the company's servants, stated that he inspected the pump in question on the 12th of October. The barrel was in bad repair, and the pump could not be used unless "fed" with water. The pump was connected with the water-closet, but witness did not think that the closet was supplied with water from the pump. He saw no india-rubber pipe connecting the company's water-tap with the closet.

Mr. Ellison, who appeared for the defendant, submitted that his client had not used the company's water, and was not bound to pay for it.

The Judge said, if defendant did not intend to use the company's water for all purposes, he must give notice to the company, who would then have to decide whether they would give him a partial supply.

Mr. Ellison said he would ask the judge not to decide the case that day, because that was not the first dispute of the same kind by a good many.

Mr. Cockerell said defendant was the first person who had refused to pay the rates.

The *Defendant* was called, and stated, when he entered the house in question, he found that there was a pump in it, which he got repaired, and he had ever since used the water from this pump for the water-closet. The pump was connected with the closet. He had never used the company's water for the closet. There was a plug fixed in the spout of the pump, so that he could not draw any for ordinary domestic purposes. The pump was in good working order.

By Mr. Cockerell: He had not been at the trouble to take out the plug in the nose of the pump and use the water from it for ordinary domestic purposes. It was false to say that the pump required to be "fed."

By the Judge: He did not use pump water for tea. He had never tasted it at all.

Mr. Beales, in giving judgment, said there was no doubt that by the 36th and 37th sections of the Act, the company were entitled to charge for the supply of water to any house in which there was a water-closet, and the question was whether defendant could successfully claim to be relieved on the ground that the water-closet was supplied from a private pump. The previous tenant seemed to have made no objection to pay in respect of the closet. The answer to that, on the part of the defendant, was that the circumstances were different. The pump was out of repair when he took possession. He repaired it, he said, and used the water from it for the water-closet, and when the collector came round he objected to pay so much as might be considered to represent the value of the water supplied to the water-closet. There was no specific item on the account in respect to the water-closet, and the judge did not well see how there could be. There was no clear understanding between the company and the tenant in regard to that, and the company continued to supply the water as formerly. Then came the question, the answer to which would decide the case, was there any communication made by the defendant to the company claiming to be relieved from any portion of his liability? The evidence on this point was that defendant told the collector that he would not pay for water supplied to the closet. Was that, according to the Act of Parliament, a sufficient notice on his part to the company, supposing any objection were tenable in a case where the water company was entitled, under their Act, to charge for the water-closets. To ascertain this point, they must consider what were the company's rules and regulations. One of these rules was to the effect that no service would be laid to any premises for a partial supply of water. Therefore, the company might say, in answer to him, supposing a proper notice had been given, "We cannot attend to that at all. We cannot furnish you with a partial supply. If you make any objection, we will cut off the supply altogether." They did not do that, and argued that they did not do it because they did not know that the defendant had objected. Then came the question, whether the objection was valid according to the principles of the Act of Parliament, or the rules and regulations of the company. These provided that any consumer who wished to be relieved from his liability to pay for water, must give the company's manager notice in writing of his intention to discontinue using the water. Defendant did not give a written notice to the manager, and he (the judge) must, therefore, consider the objection invalid. There was great force in what the company said that they would not give a partial supply to a house, but would supply the whole or none. Judgment would be given for the plaintiffs for 7s. 6d., and the amount paid into court.

Mr. Cockerell said that, as the case was brought to test a principle, he would not ask for costs against defendant.

SWANSEA POLICE COURT.—Monday, Jan. 24.

(*Before the Stipendiary and Mr.* J. Rogers.)

CONVICTION FOR BREACH OF CONTRACT OF SERVICE.

John Lock, a man in the employ of the Swansea Gas Company, was summoned for that he, being a workman, and having entered into a contract personally to execute and do certain works for the plaintiffs, on the 8th of January inst., did wrongfully neglect to do work under such a contract, for which the plaintiffs claimed £2 as damages.

Lawrence Murphy, foreman at the works, deposed that on Saturday night, the 8th inst., Lock was at the works, and had a gang of men with him. Lock was in the old house, and his duty was to knock off the lids of the retorts, and throw water on the coke. That being done, the other men came and drew the charge. Witness went to the works at eleven that night, and then all appeared to be right, but about two o'clock a.m. he found there were eight retorts undrawn. They should have had the lids knocked off and the charges withdrawn and recharged. Lock was there. Witness asked him: "James, are you not going to knock off the retorts?" He said: "No, I am a hand short." Witness said it was not much for seven to do; but defendant said he would work no more short-handed. Witness offered them 5s. if the gang would do the work, but defendant refused. Thereupon witness took off his own coat, knocked off the lids, and drew the charges. The result of the refusal of these men was a diminution of the make of gas to the extent of 30,000 feet.

Mr. *Thornton Andrews*, the manager of the works, said the stokers were expected to attend to not less than nine retorts, and they usually did more. Should one stoker be absent, the money that would have been gained by the absent man was divided among the gang. That was stated in a notice posted up in the works. During the last six months the rule for payment for short-handed work had been put into operation a dozen times, and the defendant Lock had participated in that arrangement on some of these occasions. Lock had entered into the usual agreement, and had appended his signature thereto. The absence of one member of a gang would not affect defendant's work, but would increase the work of the other men. It would not affect the earning power of Lock. On the night in question there was a diminution of 33,000 feet of gas, and the gas made was of an inferior quality. It would also result in damages to the retorts. The damage named was a merely nominal sum; the actual damage would be far greater.

A discussion then took place as to the certainty of the yield by the working of a certain number of retorts. Mr. Andrews accepted the theory of the exact

make of gas by a certain number of retorts, provided that the proper conditions were maintained; but he asserted that in this case these conditions did not exist. According to the theory, it was shown that the diminution of make was 6500 feet, but, taking the whole of the conditions of that turn, a loss of 33,000 cubic feet resulted.

Mr. GLASCODINE, who appeared for defendant, then addressed the Bench, and pointed out that his client, in this case, was the foreman and spokesman of the gang, and that it was the men, and not he, who had refused to work.

The *defendant* was then called, and said that himself, Thomas Edwards, Punshon, and Joseph Sparks constituted the gang. Punshon was a substitute for another man, and was inefficient, and was discharged at eleven o'clock. The length of his time was from six to six, and he was at work on the date in question during that time. The men refused to do the work on the night in question, and therefore he dropped it. They said they could not do it.

In cross-examination by Mr. SMITH, who appeared for the company, defendant said the men could not do the work until he knocked off the lids. He was the foreman of the gang.

Joseph Sparkes was also called, and he said the whole of the gang refused to do the work. Edwards said his hands were sore, and he could not go on. They would all have extra work in consequence of the absence of one man.

By Mr. SMITH: Lock was the first to say he would not do the work, and then the remainder said the same.

In reply to the BENCH, Mr. *Andrews* said that the diminution of 33,000 feet of gas was entirely due to the stoppage of Lock and his gang.

The STIPENDIARY, in giving judgment, said this case was essentially an action for damages brought by the gas company against defendant, for breach of contract, which was as follows:—"James Lock agrees to serve as stoker to the company for twelve months, at the wages of 29s. per week, a month's notice given or required, subject to the rules of the company," which contract was signed by the defendant; and there was a rule imported into the agreement—namely, "in the case of a gang being short-handed, the wages of the absent man shall be divided between the gang." The contract expired at the end of twelve months, by the effluxion of time, and as the parties went on, and nothing was said about the terms of the contract, any court would take it that they continued under the same terms, and it would be inferred that the stipulations of the contract were renewed or revived. The defendant refused to do the work he was bound to do under the contract. The question was, was there any excuse or justification for that refusal. He (the Stipendiary) was totally unable to see any. There was no extra demand made upon his bodily powers, and no risk of any diminution whatever of his earning power or the sum of wages he would have received. The foreman was present, and if there was any responsibility to proceed with work in the absence of one of the parties, the foreman was responsible, and not defendant. As to the advisability and safety of the work there could be no doubt, because he found that the foreman at once pulled off his coat, and, like a true British workman, he set to work to do what defendant had refused to do. He was much to be commended for behaving in the spirited and loyal manner he did to his employers. There was a considerable diminution of gas as the result of that state of things in the middle of the night, and if damages had been claimed with relation to the total diminution of gas, it would have amounted to a much larger sum than that which was actually claimed—nearly to £6. The claim put in was only one-third of that sum, and the evidence was so indisputable, as it appeared to him, that a loss to that amount, at least, was incurred in consequence of defendant's proceedings, who evidently was the first to set on foot this refusal of the gang to perform the functions they had undertaken. He could not, therefore, hesitate at all in giving a decision that the damages claimed must be paid with costs.

There was a similar case against a man named *Bond*, but on the defendant agreeing to pay the costs, the summons was withdrawn.

Miscellaneous News.

METROPOLIS WATER SUPPLY.

The following are the returns of the Society of Medical Officers of Health on the composition and quality of the metropolitan waters in January, 1876:—

NAMES OF WATER COMPANIES.	Total Solid Matter per Gallon.	Oxygen required by Organic Matter, &c.	Nitrogen.		Hardness.	
			As Nitrates, &c.	As Ammonia.	Before Boiling.	After Boiling.
Thames Water Companies.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
Grand Junction	22·53	0·051	0·165	0·001	15·9	3·8
West Middlesex	22·13	0·053	0·147	0·000	15·6	3·8
Southwark and Vauxhall	22·23	0·057	0·168	0·001	15·7	3·8
Chelsea	22·07	0·066	0·147	0·001	15·6	3·8
Lambeth	21·87	0·057	0·158	0·001	15·5	3·8
Other Companies.						
Kent	27·83	0·011	0·365	0·000	19·8	5·6
New River	21·57	0·034	0·169	0·000	15·4	3·6
East London	22·37	0·056	0·171	0·001	15·8	4·0

Note.—The amount of oxygen required to oxidize the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

The water was found to be clear and nearly colourless in all cases but the following, when it was slightly turbid—namely, in the case of all the Thames companies, except the West Middlesex. The average quantity of water supplied daily to the metropolis during the preceding month was, according to the returns of the water companies to the Society of Medical Officers of Health, 111,420,340 gallons; and the number of houses supplied was 518,606. This is at the rate of 33·7 gallons per head of the population daily. The last official return from Paris stated that the average daily supply per head of the population was 28·2 gallons; but this includes the water used for the public fountains, and for the ornamental waters in the Bois de Vincennes and the Bois de Boulogne.

HY. LETHEBY, M.B.

REDUCTION IN THE PRICE OF GAS.—At a meeting of directors of the Northampton Gas Company, held on Thursday last, the price of gas was reduced from 4s. to 3s. 9d. per 1000 cubic feet, from Dec. 25, 1875. This makes the fourth reduction in price—1s. 3d. in all—since Lady-day, 1874.

LARGE CONTRACT FOR WATER-PIPES.—An important contract has just been entered into with the Glasgow Corporation Water Committee, by Messrs. D. Y. Stewart and Co., conjointly with Messrs. Thomas Edington and Sons, Phœnix Foundry, both of Glasgow, for the supply of 2620 tons of cast-iron pipes, varying from 42 inches to 12 inches in diameter, for the River Supply Water-Works, which are now in course of construction to meet the wants of the manufacturers and other large consumers on both banks of the Clyde in the east end of the city, when the weir at the Hutchesontown Bridge is removed. In all there will be about 2½ miles of main piping, and the contractors bind themselves to have it completed in nine months from date of acceptance by the Water Committee. it is intended to have the whole of this important water supply undertaking completed by the month of May, 1877.—*Engineering*

AMERICAN GASLIGHT ASSOCIATION.

[Condensed from the Report in the *American Gaslight Journal.*]

WEDNESDAY, OCT. 20, 1875.

(*Continued from page* 134.)

Dr. CHANDLER continued his address as follows:—

The Loss of Light by the Use of Shades, Chimneys, &c., is very considerable, and largely due to the conversion of light into heat. The following numbers, selected from the results of Mr. William King, of Liverpool, and Professor F. H. Storer, of Boston, are of sufficient illustration:—

Description of Glass.	Thickness of Glass. Inch.	Loss of Light.
Clear glass, King.	—	10·57
Ground glass, „	—	29·48
Smooth opal, „	—	52·82
Ground opal, „	—	55·85
Thick English plate, Storer	1/4	6·15
Crystal plate, „	1/8	8·61
English crown, „	1/8	13·08
Double English window „	1/8	9·39
Double German, Belgian, Storer	1/8	13·00
Single „ „ „	1/16	4·27
Double „ „ ground, Storer	1/8	62·34
Single „ „ „ „	1/16	65·75
Berkshire, Mass. „ „	1/16	62·74
Orange-coloured window glass, „	1/16	34·48
Purple „ „ „	1/8	85·11
Ruby „ „ „	1/16	89·62
Green „ „ „	1/16	81·97
A porcelain transparency	1/16	97·68

Lighting Gas by Electricity has recently been introduced in theatres, halls, &c., with great advantage. As it is an instantaneous operation, it results in great economy by rendering it unnecessary to light the gas before it is actually wanted, and in sparing the attendants the great exertion required in applying the torch at great heights. It may be effected by stretching a fine platinum wire above each burner, and heating it to a white heat by a current of electricity when the gas is turned on. A better plan is to use the Ruhmkorff coil. In this case each burner is isolated from the house-pipes by a hard rubber connecting ring. A series of wires is then arranged, by which the electric current is made to leap in sparks to the tip of each burner in succession when the gas is turned on. Systems have been invented by which the gas of the street-lights is turned on and off, and lighted by electricity from a central office.

Pressure.—As already stated, a certain amount of pressure is required to force the gas through the street-mains, house-meters, pipes, and burners. The pressure is measured by the height of a column of water supported by the gas in a U-shaped tube, one end of which is open to the air, while the other is connected with the gas supply. It is estimated that there should be a pressure of 1 inch at the entrance to the premises of every consumer, 0·2 inch being required to force the gas through the meter, 0·2 inch for the house-pipes, and 0·6 inch for the burners. This pressure is exerted by the weight of the great gasholders at the works. Were the consumption of gas uniform during the entire 24 hours, the holder could be properly balanced once for all, and a uniform pressure would be exerted at all times—4 or 5 inches are found to be necessary for large districts; but when no gas is burned, no pressure is required, and when little gas is burned, 4 or 5 inches would be excessive. Consequently, the pressure must be graduated according to the hourly consumption. For this purpose the governor, already mentioned, is employed at the works to regulate the flow, and, consequently, the pressure of the gas from the holder to the street-mains. The following table exhibits the variation in pressure caused by irregularities of consumption. The holders of the New York Gaslight Company are in East Twenty-First Street; its district extends from Grand Street to the lower end of the island at Whitehall Street. Hester Street is well within the district.

Pressure of the Gas in Inches of Water.

	3 p.m.	4 p.m.	5 p.m.	6 p.m.	7 p.m.	10 p.m.	12 p.m.
Twenty-First Street	1·7	2·0	5·5	4·2	2·9	1·9	1·0
Hester Street	1·6	1·7	2·4	2·2	1·9	1·6	1·2
Whitehall Street	1·0	1·0	0·6	1·1	1·1	1·0	0·8

It is thus seen that a uniform pressure throughout the district supplied is absolutely impossible. In order to secure a sufficient pressure at the extremities of the district, an excessive pressure must be produced at the intermediate points; and as the pressure must be varied from hour to hour at the works, it will vary at the premises of most of the consumers. The consumer must, therefore, regulate the pressure for himself—1, by carefully adjusting the main-cock at the meter; 2, by adjusting the cock at each burner; 3, by using check burners; 4, by attaching a regulator at the meter. It sometimes happens that the consumer cannot get sufficient pressure to supply his burners, when he, of course, fails to get the light he requires, and concludes that the gas is poor. This difficulty may be due to several causes—1, insufficient pressure at the works; 2, the street-mains are too small, or are obstructed; 3, the service-pipe is too small, or obstructed; 4, the meter is too small, or out of order; 5, the house-pipes are too small, or obstructed; 6, the fixtures are obstructed; 7, the burners are too small, defective, or obstructed. By comparing notes with neighbouring consumers, and consulting an intelligent gas-fitter, the real cause of the deficient light can generally be ascertained. In large buildings there should be a separate cock and regulator on each floor, to prevent irregularity of pressure.

The Illuminating Power of Gas is dependent upon several conditions—1, liberation of solid particles of carbon from the olefiant gas and rich hydrocarbon vapours by the heat of the flame, or the oxidation of the hydrogen at points in the flame where the supply of oxygen is not sufficient for both hydrogen and carbon; 2, to the temperature of the flame, which renders the carbon particles luminous; 3, to the density of the materials burned; 4, to the density of the products. These conditions depend upon the chemical composition of the gas, and the manner of its combustion. Gases rich in olefiant gas and heavy hydrocarbons furnish the most luminous flames. The character of the burner, the dimensions of the chimney with Argands, and the pressure, determine the manner of combustion by regulating the supply and admixture of air. A low pressure, with a burner that secures a supply of air just sufficient to prevent smoking—*i. e.*, the escape of unconsumed carbon—secures the maximum amount of light. The pressure and quality of the gas being fixed, it was formerly supposed that the light produced was directly as the rate of combustion, and that, consequently, two like burners, consuming each 3 feet of gas per hour, would give the same same amount of light as one similar burner consuming 6 feet. Recent investigations make it extremely probable that the amount of light increases as the square of the consumption. (*Farmer's Theorem.*) Consequently, the light from the two burners would be $3 \times 3 + 3 \times 3 = 18$, while that from the one 6-feet burner would be $6 \times 6 = 36$. Thus, the large burner gives twice as much light for the same consumption as the two small burners; hence, the economy of a few large burners over many small ones.

Carbureiting or Carbonizing Gas.—It having been established that the illuminating power of gas depends upon the presence of heavy hydrocarbon vapours, numerous means have been contrived and patented for adding such vapours to the gas. The materials available are the naphtha of coal tar, and

the naphtha of petroleum or coal oil. Coal tar naphtha is by far the most effective, though most expensive. It consists of benzole, C_6H_6, and its homologues, which are very dense and very rich in carbon. Petroleum and coal oil naphtha consist of hydrocarbons of the marsh gas series (see petroleum), such as quintane, C_5H_{12}; sextane, C_6H_{14}; septane, C_7H_{16}, &c., in which the ratio of carbon to that of hydrogen is less than half what it is in benzol, &c. Dr. Letheby (*Chem. News*, xi., 1865, p. 126) found that, while one grain per cubic foot of gas of some naphthas increased the illuminating power 9 per cent., the same quantity of other naphthas raised it only 1·99 per cent. Under favourable circumstances, he found that a gallon of coal tar naphtha would enrich 6000 feet of gas, adding over 10 grains per cubic foot, and increase its illuminating power 68 per cent., thus making it equal to 10,000 feet of the original gas. The practical gain is 4000 feet, costing the price of one gallon of naphtha, about 1 dol. The conditions which effect the carbonization are—1, quality of the gas; 2, quality of the naphtha; 3, construction of the carburetter; 4, temperature of the carburetter. The last condition is very essential to success. If the carburetter is placed in a warm situation the naphtha evaporates too rapidly, the gas becomes overcharged, and the flames smoke. The burners must be adjusted to the character of the gas, and if the gas varies from day to day, from irregularity in the carbonization, the annoyance becomes intolerable. Another difficulty arises from the condensation of the naphtha in the house-pipes and fixtures, by which they become obstructed and cease to deliver gas. These difficulties have led to the ill-success which has attended this apparently logical method of enriching gas.

The Specific Gravity Test.—As already stated, the chief diluents of coal gas are hydrogen, specific gravity 0·069, and marsh gas 0·559; while the luminants are olefiant gas 0·976, propene 1·49, butene 1·94, benzole 2·71, naphthaline 4·43, &c. The specific gravity of the mixture will depend, to a certain degree, on the ratio of heavy luminants to light diluents. This does not hold true in the presence of any considerable quantity of carbonic oxide, specific gravity 0·967, as when water gas is a component; or of air, as in the Rand and Gale naphtha gas. The table which you see before you, and which is from Muspratt's "Chemistry," will sufficiently illustrate the relation of specific gravity to illuminating power in coal gas made by the usual process. The specific gravity was formerly determined by carefully weighing the gas in a light glass globe provided with a stop-cock, making suitable corrections for temperature and pressure. Recently a very simple method has been introduced, by which the operation can be accurately performed in a few minutes. The diffusive power of gases being inversely as the square of the density, the density will be directly as the square of the diffusion. It is only necessary to determine the number of seconds required for equal volumes of air and of the gas to escape through the same opening, and to divide the square of the gas seconds by the square of the air seconds; the result is the specific gravity of gas.

As the square of air seconds is to the square of gas seconds, so is 1 (sp. gr. of air) to x (sp. gr. of gas).

W. W. Goodwin, Esq., of Philadelphia, supplies the simple apparatus for this determination under the name of the "density test." (See *Amer. Chemist*, ii., 177, 216.)

Name of Coal.	Cubic Feet of Gas per 2240 lbs.	Illuminating Power in Candles.	Specific Gravity of the Gas.
1. Ponesfield	10,500	11·50	·398
2. Gosforth	10,000	12·00	·402
3. New Pelton	10,500	12·00	·415
4. West Hartley	10,500	12·50	·420
5. Pelaw	11,000	12·75	·420
6. Hasting's Hartley	10,300	12·50	·421
7. Leverson	10,800	12·50	·425
8. Pelton	11,000	14·00	·430
9. Washington	10,000	14·00	·430
10. Dean's Primrose	10,500	13·50	·430
11. Blenkinsop	9,700	14·00	·450
12. Washington cannel	10,500	18·00	·500
13. Pelton cannel	11,500	18·50	·521
14. Leverson cannel	11,600	18·00	·523

Gas from Coal Tar.—Ever since the manufacture of coal gas became an established industry, the importance of converting the tar into gas, or of so conducting the destructive distillation as to prevent its formation, has been fully recognized, and the greatest variety of processes have been patented, all of which claim to make more gas and better gas from a ton of coal. The actual possibilities are estimated by comparing the weight of tar with the weight of gas from the same coal; 2240 lbs. of average caking coal yield from 9000 to 10,000 cubic feet of gas of a specific gravity of, say, 0·430, equivalent to 296·86 or 329·84 lbs. of gas. The same coal yields, say, 12 United States gallons of tar, the specific gravity of which is from 1·12 to 1·15, or 9·33 to 9·58 lbs. per gallon, equal to 112 to 115 lbs. If this tar could be entirely converted into gas of ·430 specific gravity, it would add 3394 to 3488 cubic feet to the yield of gas. The case is still more striking when, as in some cities in England and Scotland, cannel coal is exclusively employed, cannel coal yielding 10,000 cubic feet of gas having a specific gravity of ·500, or 383·5 lbs. of gas, yields, say, 30 gallons of tar, specific gravity 0·990, or 247·38 lbs. of tar, which, if converted into gas of specific gravity ·500, would add 6449 feet to the yield of gas. The proportion of carbon in coal tar is so great, however, that under no system can it be converted into gas without the formation of a considerable proportion of fixed coke, probably from 25 to 40 per cent. of its entire weight. This fact reduces very considerably the possible gain of gas from the tar; in the case of caking coal, the usual material, from the 3394 to 3488 cubic feet of gas to not much above 2000 feet. To secure this gain, the tar, which has a market value of from 33 to 50 cents. per ton of coal, must be sacrificed, and more complicated apparatus and a larger consumption of fuel and labour must be resorted to. It is for these reasons that none of the methods suggested for producing gas from the tar have as yet been successful.

In 1818 John Grafton patented the conversion of the tar into gas by delivering it into a second retort, heated to redness and filled with iron filings, coke, &c. In 1820 Mr. Lowe contrived an arrangement of five retorts—three below and two above—for the same purpose. The retorts were charged in the usual way with coal, and when the carbonization had gone on for three hours, the tar was admitted into the back part of the upper hotter retorts by a syphon tube. Some have mixed the tar with small coal, others with peat, sawdust, porous stones, &c. In 1827 Bernard Chaussenot patented, in France, the use of one vessel or retort heated to a low temperature for distilling "resin and all hydrogenous matters, liquid and solid," into rich vapours, and a second retort heated to a high temperature for converting these vapours into permanent gas. This principle has been the basis of numerous patents—Robertson (in 1848), Gesner (1849), Hanson (1853), Gale (1858), Fryer (1868), Eveleigh (1870?), &c. While this principle has not been successful if applied to coal alone, it is probably essential to the production of gas from petroleum or any of its products, and is in successful operation in several works where petroleum naphtha is used as an enricher for coal gas, as at the Harlem and the Mutual works in New York, the Citizens and the People's works in Brooklyn, and many others. This is, after all, but a subdivision of the process which actually takes places in every coal retort, as I have already stated. The coal is always distilled at a low heat, and the condensable vapours are subsequently converted into permanent gas after they leave the coal.

Bye Products of the Coal Gas Industry.—The bye products of the manufacture of coal gas consist of—1, coke; 2, ammoniacal liquor; 3, tar; 4, the spent lime or oxide of iron used in purification. The ammonical liquor is the source of nearly all the ammonia salts of commerce. By far the larger part of the nitrogen of the coal, which varies from less than 1 per cent. to nearly 2 per cent., is not converted into ammonia; it forms cyanides, sulphocyanides, bases, &c. The strength of the ammoniacal liquor depends chiefly upon the amount of water used in washing and scrubbing the gas. The strength of the liquor is estimated in degrees (Twaddel), or by the number of ounces of oil of vitriol required to neutralize a gallon. Each degree of Twaddel is equal to about two ounces of acid per Imperial gallon. The liquor varies from 3° Twaddel to 10 or 11° Twaddel. The maximum yield of ammonia is perhaps 45 gallons of 8-ounce liquor per ton of coal, equivalent to 34 lbs. of sulphate of ammonia. The ordinary yield is about 25 gallons of 8-ounce liquor, equivalent to 20 lbs. of sulphate of ammonia. In London only about half this quantity is obtained. In 1866 there were obtained at the Paris Gas-Works 3000 tons of ammoniacal products, either sulphate or aqua ammonia, from 421,000 tons of coal, or 0·712 per cent., or 16 lbs. per ton. The ammoniacal liquor contains the ammonia in the form of hydrosulphate acid, carbonate, cyanide, sulphocyanide, chloride, and benzoate. By mixing it with lime, and blowing steam through it, the ammonia is expelled and conducted to vats containing sulphuric acid, where it is absorbed and combined as sulphate, which is obtained in crystals on evaporation. This salt is used as a fertilizer in the manufacture of alum, and for the preparation of other ammoniacal compounds.

The Tar.—The quantity of tar obtained from a ton of coal varies with the character of the coal, and the temperature to which it is exposed. The higher the heat the smaller the yield of tar; 11 to 18 United States gallons is the usual yield from caking coals, the average being about 12 gallons. The Paris Gas-Works averaged 12¼ United States gallons in 1866. Formerly there was no market for the tar, and it was thrown away. Of late years many uses have been found for it, and it has been a source of revenue to the gas companies. It is used as a rough paint or varnish for wood and iron, for waterproofing paper and felt for roofing and other purposes, for the manufacture of pitch for roofing and paving, and for the preparation of a great variety of useful and beautiful products. In fact, coal tar is one of the richest sources of valuable products known to the chemist, and its study has yielded an extremely rich harvest, both to theoretical as well as to practical chemistry, and has exerted a controlling influence on some of the most useful arts, and even upon the agriculture of large districts.

Coal tar is a very complex mixture of organic bodies, and consists largely of what are called aromatic compounds. Let me again call your attention to the diagram which shows the more important products from coal. Under the heading tar, you see nearly 40 hydrocarbons, 8 alcohols, 4 acids, 21 bases, and no one can say how many oxidized and other compounds which have not yet been identified.

The crude tar is subjected to distillation in large stills, and is separated into four portions or fractions.

1. The light oil of tar, which is lighter than water.
2. The heavy oil of tar or "dead oil," which is heavier than water.
3. The green or anthracene oil.
4. The pitch which remains behind in the still.

The Light Oil of Tar consists chiefly of benzole, toluole, &c. It is rectified and sold under the name of coal-tar naphtha, as a solvent for making varnishes, &c. From the residue or "tailings" is prepared the beautiful crystallized carbolic acid, so valuable as a disinfectant, and also as a material for preparing picric acid, the beautiful yellow dye, and the constituent of some of the new explosives. The most recent application of carbolic acid, which is not properly an acid, but a phenol, a kind of alcohol, is for the preparation of salicylic acid. This acid exists in oil of wintergreen, which is the acid salicylate of methyl. Kolbe found that this acid could be made from carbolic acid, by combining it with caustic soda, and exposing the compound to carbonic acid gas at a high temperature. Half the carbolic acid is set free, and distils over from the retort in which the operation is conducted, while a compound of salicylic acid with soda remains behind from which hydrochloric acid separates the new acid. Here is a beautiful specimen of the product. It appears as a white crystalline powder, almost colourless, and with little taste. If Kolbe's labours had ended with the discovery of this simple method of preparing this acid, you would never have heard of it, but he discovered the wonderful antiseptic properties of salicylic acid, and pointed out a thousand useful applications for it, so that it is now manufactured in large quantities. It is more powerful as an antiseptic than carbonic acid, while its freedom from taste and smell, and its harmless character when taken internally give it a far wider range of usefulness. It can be used to prevent the souring of wine, beer, milk, in fact of all articles of food. It is extremely useful in checking certain diseases, which appear to depend on the rapid development of minute living organisms, *bacteria*, such as diphtheria, &c. It is probable that we do not yet half realize the valuable purposes which this acid is capable of serving.

Besides the yellow picric acid, several other beautiful dyes are prepared from carbolic acid—for example, phenyl brown or phenicienne, grenarte brown, coraline or pacenine, a scarlet dye, and azuline or phonyl blue.

By proper rectification the coal tar naphtha is made to yield nearly pure benzole, or the mixture of benzole or toluole, which is the foundation of the great aniline industry. By subjecting the benzole to the action of nitric acid, it is converted into this yellow "oil" or "essence of mirbane," nitrobenzole, or, as it is commonly called, artificial oil of bitter almonds. This is very useful as a substitute for the real oil of bitter almonds for perfuming soap, lotions, &c. It is not really artificial oil of bitter almonds, although it has the same odour. By subjecting this nitrobenzole to the action of iron turnings and acetic acid, and distilling with caustic soda, we obtain this dark oily liquid which is aniline, a strong base capable of uniting with acids and forming salts. Toluole, another constituent of the coal tar naphtha, yields a similar series of products under like treatment, nitro-toluole, and toluidine, a base which you see is solid, but otherwise similar to aniline.

By subjecting a mixture of aniline and toluidine to the action of agents which remove hydrogen, such as mixture of arsenic and hydrochloric acids, corrosive sublimate, bichloride of tin, &c., a salt of a new base, rosaniline, is produced. This is the primary aniline colour. Rosaniline itself is colourless, but its salts are of the most beautiful pink or cherry colour in solution, while they appear as crystals with the most beautiful green metallic lustre. As I turn this jar of crystals, you can see the brilliant flashes of green and golden light from the faces of the crystals, reminding you of the Brazilian beetles.

By subjecting this aniline red to the action of iodide of methyl, or ethyl, or to the action of aniline itself, it changes to purple, violet, and finally to the most beautiful blue, the operator having it in his power to stop at any desired shades between the red and the full blue. Let me call your attention to these jars which contain solutions of a dozen or more of these different shades of red, purple, violet, and blue; and to these silks, worsteds, and cottons which have been dyed with them.

You see we have also greens, yellows, oranges, browns, and blacks among our specimens; these are all products of further changes in our aniline, by processes which our time will not permit me to explain. The black is the most intense and permanent that can be produced upon cotton. It is actually made in the fibre by applying the materials to the cotton cloth, and causing them to react and produce the black by exposure to steam.

The Heavy Oil of Tar consists chiefly of hydrocarbon oils, which are not specially interesting. It also contains naphthaline, this beautiful white solid,

which is the basis of some beautiful colours, made by processes similar to those used in producing aniline colours. We have this bright Martinus or Manchester yellow, which is a calcium or sodium salt of binitro-naphthalinic acid; this fine Magdala red, which is a distinct base, prepared from naphthylamine by agents which withdraw hydrogen. Then we have these naphthaline blues and violets.

The heavy oil contains carbolic and cresylic acids, and on this account is a valuable source of these antiseptic and disinfecting agents. The oil as a whole is an effective agent for preserving timber from decay, and as a disinfecting agent for sewers, privies, cattle-pens, &c. Thousands of gallons are used every summer in this city by the health department, for disinfecting the privies of the 25,000 tenement houses. Half a gallon of dead oil, costing four or five cents, and half a gallon of saturated solution of copperas, costing a like sum, diluted with a pail of water, is sufficient for an ordinary privy. The cost of material being not over ten cents, and the cost for labour, carts, &c., about as much more.

The green oil, which comes over after the dead oil, has recently become very important, and is the basis of a new and extensive industry. The most important dye-stuff used is the madder root, and its various preparations. They produce on cotton, with proper mordants, all shades and colours from a light pink to red, purple, lilac, violet, chocolate, and black, and these colours withstand soap better than any others. To them we are indebted for the calicoes or prints, which are manufactured to the extent of millions of yards every year.

Graebe and Liebermann have succeeded in tracing alizarine, the colouring matter of madder, to coal tar, to the anthracene, this beautiful white crystalline hydrocarbon, which is contained in the green oil of tar.

Several methods are now in practical operation for converting anthracene into alizarine; twenty factories are in operation in Europe; every steamer brings us a consignment of artificial alizarine for our print works, and the Dutch and the Alsatian farmers are ploughing up their madder fields and sowing wheat and other food crops.

All the calicoes on this end of the table were printed with artificial alizarine. Here are two pieces of like pattern, one dyed in madder, the other in the artificial alizarine, the sharpest and most experienced eye cannot distinguish any difference in their tints. An important result of these discoveries is the cheapening of these necessaries of life, which is sure to follow such additions to our manufacturing resources.

The Refuse Oxide of Iron.—The oxide of iron is used over and over again, being regenerated by exposure to the air, by which the sulphur extracted from the gas is liberated from the iron and left as free sulphur. When the proportion of sulphur reaches 40 or 50 per cent., the mixture is treated for the extraction of the ammonia salts and sulphur, the purified oxide of iron being then returned to the gas-works to be used again. The refuse iron contains considerable cyanogen, which may be extracted by potash, and sold as yellow prussiate. The spent lime is very offensive when fresh, as explained under purification, and is useless for any purpose. After being weathered, however, it may be used with advantage as a fertilizer. Dr. A. Völcker gives the following analysis of weathered gas lime, dried at 212° Fahr.:—

Caustic lime	18·23
Carbonate of lime	49·40
Sulphite of lime	15·19
Sulphate of lime (gypsum)	4·64
Magnesia and alkalies	2·53
Oxide of iron and alumina	2·49
Phosphoric acid	A trace.
Insoluble sand, &c.	0·28
Water of combination, with a little organic matter	7·24
Total	100·00

The fresh gas lime contains considerable sulphide of calcium and hyposulphite of lime, which makes it useful for removing the hair from hides.

(*To be continued.*)

THE ECONOMIC USE OF COAL GAS FOR LIGHTING PURPOSES.

By Mr. B. M. M'Crae.

On Wednesday evening, Jan. 19, a Lecture, on the above-named subject, was delivered in the Lecture Hall of the Free Library, Dundee, by Mr. B. M. M'Crae, Manager of the Corporation Gas-Works.

The Chairman (Mr. A. Maxwell), in introducing the lecturer, said: I dare say there are some here present who recollect the appearance of the town before gas-lighting was introduced. I myself have a vivid remembrance of the time when some of our outlying streets were without gas-pipes, and had, at wide intervals, an oil-lamp which the visit of the *leerie* with his torch could light up only into a faint glimmer. The *rashie-wick cruizie*—a reproduction of the ancient Roman lamp, and which hung upon the mantle-shelf, was the usual light in a working man's house. But even it was an improvement on what was usual in farmers kitchens near town, where the herd-boys evening work was to keep alight and hold up a succession of resinous pine wood splints, this being the only light allowed for the family avocations. Gaslight was first used in Dundee about 55 years ago by Andrew Small, tinsmith, in his shop on the south side of the High Street, being manufactured in the fire-place of his cellar. I am told that the illumination effected was quite a sight in the town. About the same period Dr. Wise had his house at Hillbank lighted up with it. He invited a party of friends to dinner to witness its success; but, unfortunately, and to the doctor's chagrin, the new light went out, the discarded candles were replaced, and he had to submit to the condolence of his good-natured friends. The gas company began to light the town in 1826, exactly half a century ago. Its then capital was £14,664. In 1846 the new company started with a capital of £27,460. In 1868 the works and plant of both companies came into the hands of the gas commissioners. The price paid was fixed by arbitration at annuities of £6125 to the old company, and £2537 to the new, both being equal to a capital sum of £216,550. The expenses connected with the transfer amounted to about £30,000. Since then, the Commissioners have laid out considerable sums upon the works, which are now as well arranged and equipped, and produce as good and economic results, as any in Britain. Gaslight at its first introduction was costly, and for a time did not come into general use. But by-and-by, as its advantages in economy, in cleanliness, and in security were recognized, it soon became almost a necessity, and the consumption increased even more rapidly than the increase of our manufactures and population. I note the price and consumption at various periods:—

Year.	Cubic feet.	At
1825-26	1,328,000	15s. 0d.
1826-27	3,949,000	15 0
1830-31	9,805,000	12 0
1840-41	30,848,000	8 3
1855-56	96,878,100	5 6
1860-61	129,659,900	5 6
1865-66	189,599,000	4 8
1868-69 (the year of transfer)	210,500,000	5 4
1870-71	214,295,000	4 6 less 5 p. c.
1874-75	268,945,600	5 8 less 5 p. c.

Of course the daily consumption depends upon the season and state of the weather. About midsummer the quantity is as low as 250,000 cubic feet, while on some of the recent dull days in December it amounted to 1,700,000. On Hogmanay, which might be denominated our annual feast of lanthorns, there was consumed the large quantity of two million feet, being a value of £475. The account looks big, but I wish the liquor bill for that night had been no larger. The price of the gas has, in the course of these fifty years, varied considerably. For the first three years it was 15s.; then it fell by an almost annual reduction till, in 1846, the year the new company started, it was 6s. In 1865 it had been reduced to 4s. 8d., but had risen at the period of the transfer of the works in 1868 to 5s. 4d. Since then it has been allowing 5 per cent. discount.

1869-70	4s. 9d.	1873-74	5s. 8½d.
1870-71	4 3	1874-75	5 4½
1871-72	3 11½	1875-76	4 9
1872-73	3 11½		

Of course the cost of production depends to a great extent on the price of coals, and the economy of the establishment may be fairly tested by comparing its price with the cost of the gas to consumers. I find that during the last seven years that the works were in the hands of the companies the average price of coal was 18s. 9½d. per ton, showing a cost of 1s. 8½d. per 1000 cubic feet of gas produced. During the same period, the average price of gas was 4s. 10¾d. per 1000 feet. Since then, during the seven years the commissioners have had the works, and which period includes two years of extraordinary high rates, the average price of coal has been 24s. 6¾d., or a cost of 2s. 2¾d., per 1000 feet, while the average price of gas during the same period has been 4s. 8d., showing that while the coal required to produce 1000 feet of gas cost the commissioners 6¼d. more, they have sold the gas at 2¾d, less, being equal to a public saving of 9d. per 1000 feet. And this result has not been attained by a sacrifice of the quality, for the gas produced since the commissioners acquired the works has averaged at least two candles more illuminating power than that made previously. To the ability, the energy, and the activity of Mr. M'Crae, the worthy manager of our works, much of this success is due. He is an eminently practical man, and while he has well considered the economic production of gas, he has not neglected the hardly less needful study of its economic use. On this subject he is to night to address us, and the commissioners feel that they are only doing their duty by pressing what he has to say upon the attention of the public.

Mr. M'Crae said: It may be asked, Why is it necessary to read a paper on, and to illustrate by a few simple examples, the economic use of coal gas for illuminating purposes to persons the majority of whom have been using gas all their lifetime, and many have used it for about half a century? At first sight it does seem superfluous, but it is nevertheless necessary, very necessary, as I trust to be able to-night to prove. Some of you are aware that in Dundee, as well as in many other towns of late, there have been persons complaining of the quality of the gas supplied. Complaints against the quality of the gas supplied have periodically turned up almost everywhere where gas has been used, sometimes to an extent that proved disastrous to many individuals, and even communities have not all been exempted from their share in the consequences. While I do not say that there never was, nor is, cause for complaint against those who supply the gas, I am confident that in every case the defective means used to consume the gas have had much to do in causing grounds of complaint, and in many cases the cause has been entirely due to such defect. Many have been the attempts made by chemists and others to instruct the people how to use their gas economically, but still there are comparatively few persons who trouble themselves much about the matter further than now and again to complain. Why this is so, I think, is easily explained. Scotland has been favoured beyond any other part of the kingdom by deposits of very rich cannel coals, which have enabled gas manufacturers to supply gas of very high illuminating power, so high that gas consumers as a rule get as much light therefrom as satisfies them; but it does not follow, as I trust to-night to be able to show, that the people of Scotland have been or are receiving the benefit of their rich gas. The fact is, taking the burners as they generally are used under the circumstances generally existing, it may safely be said that nearly one half of the light contained in the gas is never seen by the gas consumer. Another reason why gas consumers have not been sufficiently educated as to how they should use their gas is that till lately almost all gas consumers everywhere were supplied by dividend paying companies, whose interest lay in the direction of increased consumption of gas, not in an increase of light from a less volume of gas. From this last-named position Dundee is free; and here let me say that the Gas Commissioners of Dundee have always, and still are, very anxious that Dundee should be supplied with first-class gas. Notwithstanding that their Act of Parliament only requires them to supply 18-candle gas, they have, ever since they got possession of the works, supplied gas of an average quality of from 26 to 28 candle power. Several of their number, including my late and present conveners of works, have taken such interest therein that it led them to suggest to me the propriety of my appearance before you to-night in the performance of the duty which I have undertaken. If I am in any degree successful in helping any to a more economical use of gas, whereby an increase of light may be obtained, or a less volume of gas be required, I shall feel glad that I was encouraged to do so by the Gas Commissioners. The illuminating power of gas is expressed by so many candles. Whether the gas may be 10, 20, or 30 candles, theoretically the results are arrived at in each case in the same way. Parliament has laid it down as the only legal mode of testing gas that the burner used must be capable of passing 5 cubic feet of gas per hour, at a pressure of not over 5-10ths of an inch. By pressure you are to understand that the force of the gas immediately under the burner shall raise a column of water in a tube the distance named. The candle used is made of pure sperm, 6 of them to weigh one pound. The wick is so arranged that the consumption of sperm per hour shall be 120 grains. You will easily understand that it is rather a difficult thing to regulate the pressure so that the consumption of gas is exactly 5 feet per hour, and to get the candle in all circumstances to consume exactly the 120 grains of sperm per hour. Recourse, therefore, has to be had to a system of corrections, by weighing the candles before and at the end of each experiment, and by correcting also for the state of the meter as indicated. The other parts of the apparatus are not so easily explained in words to make it plain. Any one anxious to know more about it will be made welcome to visit the laboratory at the gas-works, where they will see it, and get it explained. After the corrections named have been made, there are still others which have to be attended to, when the truth is really wanted—viz., the state of the barometer and of the thermometer. A given volume of gas at, say, 30 inches of the barometer and 60° of the thermometer is not the same volume at any degree above or under those named. Some people, however, not being over particular, ignore these and even some of the more important corrections, finding that they can get a nominally higher result by saving themselves the trouble. In Dundee all these are carefully adhered to. Here is a sample of the candle used, and here is a sample of the burner used, passing at the rate of 5 feet per hour, both as nearly as possible in the condition in which they are when the gas is being tested. Now comes the difficulty—to reconcile the result obtained in the photometer room and the results we find at consumers burners. People will not believe, when they look at their burners, giving—as a large majority of them do—a very miserable light, that the gas is anything like what it is said to be. I do not wonder at this. The wonder often to me is why the people submit to it at all. I will now show you an example of a burner by which gas is used, and the poor result therefrom, and how easily almost three times the quantity of light can be obtained from the same volume of gas. The lecturer here proceeded to remark, You will observe that our display of apparatus is of the most simple kind, intentionally so. The circumstances in each of the examples that are to be given will be what exists all over the town, showing the light from a No. 1 Bray's Union burner, which, he said, passed at 1-inch pressure 2·2 cubic feet of gas per

hour. He remarked that no one could say this was a good light. You would be quite justified in pronouncing it miserable. Bad light as it is, that burner is passing gas (as previously stated) at the rate of 2·2 cubic feet per hour. All the light you are getting, therefore, is only equal to four candles. If 2·2 cubic feet give four candles, what would five cubic feet give? About 9 candles. That is all the light we can get under the circumstances from what in reality, when the test was made, was 29-candle gas. Here is a loss of illuminating power of 20 candles; or, in other words, taking the cost of each candle per 1000 feet at 2d. there is a loss of 3s. 4d. worth of light out of every 1000 cubic feet of gas consumed. What is the cause of this? The pressure is too great, which forces the gas into the atmosphere too rapidly. The contact with the oxygen becomes so intimate that an immediate combustion of the carbonaceous particles takes place. Hence the destruction of the light. Exhibiting a Bunsen burner, he said—To enable you more completely to understand what effect a current of atmosphere has in destroying the light, I have a burner here, the name of which is the Bunsen burner. By artificial means a very much increased current of air is brought into contact with the flame by which you will observe that the whiteness of the flame is entirely destroyed. This burner, however, valueless for lighting purposes, is of great value in producing heat for cooking purposes, or in heating small greenhouses and wherever heat is desired. Again, returning to the No. 1 Bray's Union burner, the lecturer proceeded—We shall change the circumstances by a very simple method of procedure. We will connect by a short piece of tube a No. 6 Bray's burner to the top of this No. 1 burner, allowing every other condition to remain the same as before. You can, at a glance, see that the difference in the illuminating power is immense. The same quantity of gas is being used—viz., 2·2 cubic feet per hour. By the application of the large burner the pressure is reduced between the top of the small burner underneath and the outlets of the large burner to under three-tenths of an inch of pressure whereby the gas is permitted to issue slowly into the atmosphere. Very little current is formed; the oxygen of the atmosphere is allowed to come into contact with the gas in a gentle, easy manner, whereby the carbonaceous particles contained in the gas are properly heated—not destroyed as was the result with the small burner alone. Here you have a light equal to nearly 12 candles from the 2·2 cubic feet per hour, which by the rule of three gives over 26 candles. In the first experiment we lost 20 candles of the light; in this we lose only about 3 candles. Let me add here that if the gas had been only 26 or 27 candles the result would have been as nearly as possible the same; the richness of the gas above that figure is not easily made available. These experiments introduce us to the principle of the Brönner burner, which has a small opening at the lower end and a large opening at the top. Here (showing one) is a Brönner burner passing gas at the rate of 3·2 cubic feet per hour at one-inch pressure under the lower end, giving a light equal to 14 candles, which, compared with the 5 cubic feet burner, is equal to 22 candles. The gas, when this burner was tested, was 28 candles. There is therefore a loss of six candles. You are not to suppose that there is any virtue in this kind of burner, nor in the double burner which you have just seen. We get the same result by using the large burner alone by reducing the pressure to about three-tenths of an inch. Here (showing one) is a No. 6 Bray's burner, passing at the rate of 2·2 cubic feet per hour, at three-tenths pressure, giving a light equal to 11·5 candles, which, compared with the 5 cubic feet burner, is equal to over 26 candles. The gas, when this was tested, was 26 candles. There is therefore a loss of about 3 candles. I would here warn any who may adopt these burners at this low pressure to be careful that the pressure is not permitted to be greater; otherwise the gas bills would be increased to a mischievous extent. Care is also necessary to prevent currents of cold air from blowing on the lights, which cause them to give off smoke. The small burner under the large one, and the principle of the Brönner burners, which are practically the same, no doubt helps to do what gas consumers are not always willing and ready to do for themselves—viz., to check the flow of gas at the stop-cock. The small burner, or opening at the lower end, is nothing more nor less than an obstruction. It is proper here to explain why this or any other manipulation is necessary to check the pressure. It was not enough, however, he said, to fit up their houses with proper burners, because the pressure was continually varying through people lighting up and shutting down their lights. What, then, he remarked, is the remedy? A regulator. Nothing else will effectually do the duty; this regulator will. Regulators are useful everywhere. In Dundee, where the gas has to be sent to such heights, they are indispensable. They are now being made very cheap, and very accurate in their working. When they are properly fixed and balanced to suit the circumstances of the house, shop, or factory, you may then rest assured that your trouble and waste of gas are at an end. All the variations of the pressure will not affect your lights. The saving of gas would pay the cost of a regulator in a very short time, not to speak of the great pleasure to be derived from steady good lights. I have shown you a few experiments to prove the enormous waste of light which takes place by using improper burners. These experiments have been made by arrangements of burners as best to show this. I will now give a few illustrations of a variety of burners, such are in common use. I thought this necessary, that there may be a direct comparison. Showing eight burners, from No. 0 to No. 3 union, and from No. 0 to No. 3 bat's-wing, the lecturer proceeded: I will give the rate of consumption per hour of each, the actual illuminating power obtained, with the loss of light by each, compared with that which ought to be got. The pressure we use on these eight burners is 14-10ths of an inch, that being a fair average pressure over the town. There are districts and buildings where the pressure is less in consequence of defective mains, or, as is no uncommon thing, defective interior fittings; but there are districts where the pressure is considerably over what we have taken for the example now to be given:—

Name of Burner.	Pressure in Tenths of an Inch.	Consumption per Hour. Cubic Feet.	Light in Standard Candles.	Light calculated to 5 Cubic Ft. Consumptn.	Illuminating Power of Gas when Burner was Tested.	Light Lost. Stand. Candle.
No. 1 Union, Bray's	10	2·2	4	9	29	20
Nos. 1 & 6 do., do.	10	2·2	11·5	26·1	29	2·9
Brönner	10	2·2	14	22	28	6
No. 6 Union, Bray's	3	2·2	11·5	26·1	29	2·9
„ 0 „ iron .	14	2·0	3·5	8·75	29	20·25
„ 1 „ „ .	14	2·5	6·5	13	29	16
„ 2 „ „ .	14	3·5	13	18·6	29	10·4
„ 3 „ „ .	14	5·5	26	23·6	29	5·4
„ 0 Bat's-wing, iron. . . .	14	2·5	6	12	29	17
„ 1 „ „ .	14	3·25	10	15·4	29	13·6
„ 2 „ „ .	14	4·5	16	17·7	29	11·3
„ 3 „ „ .	14	5·0	24	24	29	5
„ 4 Union, Bray's	5	2·5	9	18	27	9
„ 3 „ „ .	5	1·6	5·5	17	27	10
Double-slit bat's-wing, Olding's.	5	2·9	15	26	28	2
No. 1 Union, iron, and large Steatite, bat's-wing.	14	2·6	13·5	26	28	2

You will observe in these details that the smaller the burner the loss of light is the greater in proportion to the quantity of gas used. The larger burners always give the best results. None of these burners give good results used in the circumstances which we have now done. Still such is, as fairly as I can put it, a true comparison of what we find generally over the town. To sum up, the average consumption of gas per hour by these eight burners is nearly 3·6 cubic feet. The average light obtained therefrom is 13·12 candles. The average light, calculated at a consumption of 5 cubic feet per hour, is 16·64 candles—say, for convenience, 17 candles. The illuminating power of the gas when these burners were tested was over 29 candles. We have, therefore, a loss of over 12 candles over the whole. I have been requested by a Dundee gentleman who takes great interest in gas matters to exhibit and explain another burner. Producing the burner, the lecturer said, the only name I have for it is Spurling Olding's double-slit burner. You are aware that the common bat's-wing burner has only one slit. This one has two, just as if it were two ordinary bat's-wings squeezed into one, but keeping the slits entire. This burner is passing gas at the rate of 2·9 cubic feet per hour, at 5-10ths pressure. It is giving a light equal to 15 candles, which, being compared with the 5 cubic feet burner, is equal to 26 candles—a very good result, and as nearly as possible identical to the result from the No. 6 Bray's burner. One objection to this double-slit burner is, as you will observe, the formation of the flame is not pretty. There is another burner which I have received from an establishment in which there is perhaps the largest variety of burners in Dundee—the *Advertiser* office—which is very well adapted for small consumers who cannot afford the expense of regulators. It allows the gas to expand by running it through a short length of tube between a No. 1 and a No. 3 burner, and, as you will see, the light is thereby very much increased. I do not know any name for this, unless it be the *Advertiser* burner. Gentlemen, perhaps you are thinking that I am taking up too much of your time by these details. The only excuse I offer is the importance of the subject, when we know that over one third of the light manufactured and sent out from the gas-works is, in consequence of improper burners and lack of care in checking the pressure, lost. This loss in Dundee represents a money value of not less than £15,000 every year. In other words, if the gas consumers of Dundee used burners of proper construction, and under suitable circumstances as regards pressure, and were content with the quantity of light they presently have, about £15,000 worth of gas that is now manufactured and sent out every year would not be required; or, if gas consumers wish to have one third more light from the quantity of gas they now use, they can have it if they choose. The subject is important from another standpoint. I have referred to-night to the deposite of rich cannel coal with which Scotland above all other parts of the kingdom has been favoured. These deposits of high-class coals are nearly exhausted; whereby the day is not far distant when the people of Scotland, more, especially in large towns, will be compelled to use 18 or 20 candle gas. They will then learn how to use such gas to obtain sufficient light. Personally, I do not fear the consequences of being subjected to the use of 18 or 20 candle gas, being quite certain that with proper care a better and much cheaper light will be enjoyed from gas of that quality than what, as a rule, is got at present. In the face of these simple facts, I think all will admit that there is great need for more care and attention to the proper use of gas. I think it will also be admitted that it is great folly in any community to wilfully waste so much money as is presently being done, by increasing the first cost of the gas in making it so rich, and making such abuse of it by wasting it at the burner. Let us suppose that there is a town supplied with what is termed 30-candle gas theoretically; the consumers of such gas use No. 1 and No. 2, or even No. 3 burners. They are not getting over two thirds of the light contained in the gas. Let us suppose another town supplied with 20-candle gas; and this gas being much more easily made available than the other, they get about the full theoretical light at the ordinary burners. All else being equal, the consumers of the rich gas would require to pay from 1s. 6d. to 2s. more per 1000 feet than would be required in the town supplied with 20-candle gas, and from what we have seen to-night the one town would be as well lighted as the other. It may be said, improve the burners and all else necessary to utilize the rich gas. This you will have observed, we are unable to do. The richer the gas is the greater the difficulty (in practice) in getting the theoretical illuminating power. Every community has a right to get clean gas, and where it is not clean they ought to demand that it shall be so; but no community should allow its money to be spent in making gas of such high quality that it cannot be used without great loss.

On the motion of the CHAIRMAN, a hearty vote of thanks was passed to the lecturer.

GAS-BURNERS.

By Mr. JOHN PATTINSON.

The following Paper was read by Mr. John Pattinson, analytical chemist to the Newcastle Corporation, at a Meeting on Thursday night of the Newcastle Chemical Society, of which he is the president:—

How best to burn coal gas so as to obtain the greatest amount of light it is capable of producing, is a subject which is perhaps as yet but imperfectly understood, even by those who know most about it. Great improvements have, however, been made in recent years in the construction of gas-burners, resulting from the researches of Frankland, Bowditch, Sugg, Silber, the London Gas Referees, and others; but from many causes, chiefly perhaps for want of information on the subject amongst the general public, these improved burners have come but very slowly into use. The gas fitters, to whom the choice of burners is usually left, often know as little about the subject as any one, and thus a wretchedly bad kind of burner is in many cases used, which burns the gas so as to destroy a great portion of its light-giving power. In the present paper no attempt is made to describe even a tithe of the multiplicity of burners which have been invented. The object is simply to describe the results of an examination I have recently made of a number of burners taken off fittings in various parts of Newcastle, and to show how unfit these burners are to develop the light-producing properties of gas as compared with good burners which may be had quite as easily as the bad ones. Gas-burners may be divided into two great classes. First, Argands, such as give a ring of light, and require glass chimneys; and second, flat-flame burners, which may be sub-divided into what are known as "bat's-wings" and "fishtails," so called from the shape of the flames they produce. In the experiments I have made the gas used was of the same quality throughout the whole of the tests. It gave a light equal to 14·1 standard sperm candles when burnt at the rate of 5 cubic feet per hour in the standard Argand burner, known as the Sugg-Letheby burner. Before about seven or eight years ago, this was the best burner known; and as it was in use at the time when the Newcastle and Gateshead Gas Company obtained their Act of Parliament, it is still retained as the standard by which the gas is tested. It is but fair to state here that the quality of the gas was unusually low when the experiments were made, the gas usually being equal to about 15 standard candles. It may be explained, for the benefit of the uninitiated, that the standard sperm candle with which the gas is compared is one defined in the Act of Parliament as a "sperm candle of six to the pound, burning at the rate of 120 grains per hour." I will first of all give the results of the testing of Argand burners. The Argand burner when properly constructed, is the best one adapted for obtaining the greatest amount of light from common coal gas. The air-supply, upon which so much depends, is most perfectly under control in such burners. Argand burners are certainly more expensive in their first cost, and perhaps are more troublesome to keep in order than flat-flame burners, owing to the occasional breakage of chimneys and other causes, but it will be seen that the amount of light they can produce in comparison with the latter is very great, and would soon compensate for their extra cost and the extra trouble of keeping in order, especially in private houses. They require the gas to be supplied to them at a uniform pressure, otherwise they are liable to smoke when the pressure is increased, and more gas passes through than they can burn. They should, therefore, always be used with regulators for regulating the pressure of the gas. These may be conveniently placed near the supply

meter. In each of the following tables the first column shows the actual amount of gas consumed per hour in cubic feet during the experiments; the second gives the illuminating power of the gas consumed expressed in standard sperm candles; the third gives the illuminating power calculated per five cubic feet of gas.

Argand Burners.

Kind of Burner.	Cubic Feet of Gas Used per Hour.	Illuminating Power in Candles.	Illuminating Power per 5 Cub. Ft. of Gas per Hour.
Sugg-Letheby Standard	5·0	14·10	14·10
Sugg's "London" Argand	5·0	15·90	15·90
" Improved "London" Argand	4·5	16·08	17·86
Silber's Argand	5·0	17·80	17·80
Common Argand	5·0	11·20	11·20
" "	7·0	17·80	12·70

The common Argand here mentioned was one similar to a great number used in shop-windows in Newcastle. It will be seen that, with the Sugg's improved "London" Argand and Silber's Argand, as much light is produced when burning five feet of gas as is produced when burning seven feet of gas in the common Argand, thus showing a saving of 40 per cent. over the last-named burner. Flat-flame burners do not consume the gas so as to give as much light, from a given quantity of gas, as Argands. This is, perhaps, chiefly owing to the circumstance that it is necessary to make the gas issue from the burners under a certain amount of pressure, in order to produce the required shape of flame; and this pressure causes a portion of the gas to mix with too much air, so that it becomes over burnt, as in the Bunsen burner. The best flat-flame burners are those in which the pressure is reduced to the minimum amount found necessary, and such burners generally have some contrivance for checking the pressure of gas supplied at the mains. But, although flat-flame burners are not so economical as Argands in their consumption of gas, yet they possess other advantages which, probably, will always cause them to be extensively used. The first cost of the burner is very trifling, no chimneys are required, they are not so liable to smoke under varying pressure of gas as Argands, and they are easily lighted and attended to. It is in this class of burner that the most extraordinary differences in quality for burning gas, so as to produce light, have been found. The following table shows the results of my tests of various new bat's-wing and fishtail burners which can be had in Newcastle. Some of the burners were tried with different consumptions of gas:—

New Bat's-wing and Fishtail Burners.

Kind of Burners.	Cubic Feet of Gas Used per Hour.	Illuminating Power in Candles.	Illuminating Power per 5 Cub. Ft. of Gas per Hour.
Bray's No. 4 fishtail	4·0	5·02	6·28
Same burner	5·0	5·80	5·80
Bray's No. 6 fishtail	5·0	9·00	9·00
" No. 8 "	5·0	11·80	11·80
Same burner	7·0	14·21	10·15
Brönner's No. 4 bat's-wing	4·0	10·10	12·62
Same burner	5·0	11·60	11·60
Sugg's No. 4 bat's-wing	4·0	8·40	10·50
Same burner	5·0	10·90	10·90
Bat's-wing, with narrow slit	5·0	8·60	8·60
Bat's-wing used in street-lamps	5·0	11·60	11·60
Fishtail, with small platinum disc in flame	5·0	10·20	10·20
No. 5 fishtail, metal top	5·0	7·50	7·50

It is difficult to get exact uniformity in the same kind of burner of each manufacturer, and the above burners may be inferior to others of the same kind. They were, however, selected at random. The results show that the best Argand burners produce upwards of one-third more light from the gas than the best of the flat-flame burners; so that, taking light-producing properties alone into consideration, there is an advantage to this extent in favour of Argand burners. Bray's, Brönner's, and Sugg's are all good burners. It will be seen that Bray's No. 8 fishtail is much better adapted for burning the kind of gas experimented with than the No. 4 and No. 6 fishtails of the same maker. The next table gives the results of my trials of various burners recently taken from fittings in houses in several parts of Newcastle:—

Burners in Use in Newcastle.

Kind of Burner.	Cubic Feet of Gas Used per Hour.	Illuminating Power in Candles.	Illuminating Power per 5 Cub. Ft. of Gas per Hour.
Bat's-wing, metal top	5·0	9·26	9·26
" " double slit	5·0	8·90	8·90
Fishtail No. 3, metal top	3·5	4·10	5·85
" No. 3, steatite top	3·7	4·40	6·00
" No. 3, "	4·0	3·00	3·75
" No. 4, "	4·9	5·20	5·31
" No. 5, "	5·0	7·80	7·80

It thus appears that burners are in use in Newcastle which give a light equal to only 3¾ when burning the same quantity and quality of gas as, when burnt in a good Argand, will give a light equal to 17⅞ candles; or, if burnt in a good burner of its own class, will give a light equal to 12½ candles. And such burners are very extensively used in Newcastle. Is it then a matter of wonder that we occasionally hear complaints of the bad quality of Newcastle gas? By the substitution of good burners for these wretched ones, from three to five times the amount of light will be produced from the same amount of gas, or, if the light of the present burners is sufficient, the same amount of light can be obtained from one-third or one-fifth the amount of gas. In the latter case, besides the saving in the cost of gas, there is also the additional advantage of having the vitiation of the air of the room by sulphur compounds and carbonic acid from the burning gas reduced to the same extent. It is in the hope that public attention will be called to this matter, and the wasteful misuse of gas prevented, that these results are now published.

ILLUMINATIONS AT CALCUTTA ON THE VISIT OF THE PRINCE OF WALES.

The success attending the efforts of Mr. James Blackburn, the engineer of the Oriental Gas Company, in the arrangements made by him in connexion with the recent illuminations at Calcutta, in honour of the visit of the Prince of Wales, have been handsomely acknowledged by the Illumination Committee in the following letter:—

"*Reception of H.R.H. the Prince of Wales.*

"*Municipal Office, Calcutta, Dec.* 27, 1875.

"Dear Sir,—I am desired by the president of the Executive Illumination Committee to convey to you his thanks for the marked success of the gas illuminations, which were supplied by you on last Friday evening as part of the general illumination, in honour of His Royal Highness the Prince of Wales.

"Your personal exertions to secure that success can be known to no one better than the president of the Executive Illumination Committee. Your disposition of special devices and lamp-post illuminations throughout the long line of the Royal procession was most judicious, and in the best taste, which, combined with the extra provision of gas, all of excellent quality, that you had arranged for, materially assisted in producing the brilliant result that called forth general admiration. The president also desires that you will oblige him by conveying his thanks to your assistants, and giving each a copy of this letter.

"Yours faithfully,

"(Signed) N. A. Chick, Secretary, Illumination Committee.

"J. Blackburn, Esq., Manager, Oriental Gas Company."

The *Indian Daily News*, of Dec. 27, 1875, also bears testimony to Mr. Blackburn's admirable arrangements in the following terms:—

"There is one duty that should not be omitted, and that is, to award a just tribute of praise to Mr. Blackburn, the obliging agent of the Oriental Gas Company. The public is probably little aware how much the success of the illuminations is owing to his judgment, determination, and practical knowledge. There were demands for gas far in excess of any possible supply, but Mr. Blackburn wisely resolved not to entertain applications beyond his power to meet; and yet, by husbanding his resources here, and expanding them there, he enabled the public to produce that grand result which leaves Calcutta still famous for her illuminations, and no small share of the credit is due to Mr. Blackburn. Knowing what condemnation would have fallen upon him had there been a failure, we deem it only fair to give credit for success where it has been so justly earned. The success has not been the result of accident, but of ability and consideration to attain an end that has been fully accomplished."

IRON AND COAL TRADES OF SHEFFIELD, SOUTH YORKSHIRE, AND NORTH DERBYSHIRE.

(FROM OUR OWN CORRESPONDENT.)

It is a somewhat remarkable fact that, notwithstanding the excessive depression of the finished iron departments, the price of almost all descriptions of pig iron is everywhere well maintained. In Scotland, certainly, there has this week been a slight downward movement, but it is probably only the result of over-speculation, and will react in the other direction within the next few days. Pig iron of North of England production is firm at the prices quoted last week, and is likely to remain so, especially if the existing differences between masters and men in Belgium and Luxemburg should result in strikes. Hematite pig irons of West Coast make have gone up 2s. 6d. per ton during the week, a fact which will doubless tend to check that over-speculation which is one principal cause of the rise being maintained elsewhere. In this immediate vicinity the local pig irons are very steady, a great proportion of the entire output of North Derbyshire being sent into Lancashire and the South Staffordshire district.

At one or two of the largest iron-works in the country—situated at Sheffield—the puddlers having been served with notices of a reduction in wages, have held meetings, and threaten to go out on strike if the reduction be persisted in. Messrs. John Brown and Co., Limited, Atlas Works, propose a drop of about 5 per cent., whilst Messrs. Charles Cammell and Co., Limited, Cyclops Works, have asked their puddlers and ball furnacemen to accept a reduction of 1s. per ton from the present rate of 10s. per ton, or about 10 per cent. At the present time the men of this class in Sheffield and district are said to be receiving 1s. 8d. per ton more than their *confrères* elsewhere.

The coal trade remains in a comparatively dull condition, for the time of the year. The members of the South Yorkshire Steam Coalowners Association met at Barnsley on Tuesday last, and after some discussion resolved to make no alteration in prices at present. This class of fuel is therefore still quoted at 10s. 6d. per ton to the railway companies, who are naturally the largest buyers of it, and 11s. to 11s. 6d. per ton for shipment. Gas coal ranges from 8s. 6d. to 10s. 6d. per ton; these prices, of course, being at the pits, delivered into railway waggons. The price of South Yorkshire steam coal generally rules the whole of the kingdom. Many of the new collieries are now getting into operation, so that the output will shortly be very considerably augmented—probably to the extent of 30,000 tons or more per week before next winter sets in.

IRON AND COAL TRADES OF SOUTH STAFFORDSHIRE AND EAST WORCESTERSHIRE.

(FROM OUR OWN CORRESPONDENT.)

There is little noteworthy alteration in the condition of the iron trade of this district since last report. The leading makers of branded iron continue to find steady employment, chiefly on account of the Home Government; best sheets and plates are in moderately active request, and prices in this department are fully maintained. Sheets are quoted £11 to £13 per ton, and boiler plates £12 to £13 per ton. In unmarked iron, however, the trade rules dull, and local makers complain loudly of the competition on the part of North of England producers, which appears to be increasing in severity.

In pig iron the market continues quiet, but prices are well supported, owing to the restricted make.

The annual meeting of the Ironmasters Association was held at the Queen's Hotel, Birmingham, on Thursday last, under the presidency of Mr. J. P. Hunt. The principal subject of discussion was the proposed wages board, and it was ultimately resolved—"That this meeting, having taken into consideration the proposal for the constitution of a wages board submitted by the chairman and secretary, is strongly convinced of the necessity of of organizing, at once, a plan for the settlement of wages questions, and requests the committee to take such steps as are necessary for the carrying out of the same."

The demand for coal, though decidedly quieter than recently reported, is still fairly active. List rates are fully maintained for best qualities of fuel, but, in respect of the commoner descriptions, underselling now prevails to some extent. At Wednesbury the wrought tube trade continues to show a steady improvement, and the engineering ironwork establishments are in steadily sustained operation. The foundry trade is also good, and the leading makers experience a fair demand for machine castings, gas and water mains, and other heavy descriptions of produce.

THE LANCASHIRE COAL AND IRON TRADES.

(FROM OUR OWN CORRESPONDENT.)

There is a general want of activity in the coal trade of this district. The demand is very much below the average for the time of the year, and very little more than is customary during the summer months. In the Manchester district, colliery proprietors are doing very little in house coal, and prices have a tendency to be weak. As yet there have been no reductions of any moment, and these have been chiefly confined to special shipping orders, or to large purchases which buyers have made on speculation. In the south and west Lancashire districts many of the pits are not now running full time, and list prices are very difficult to obtain. The pit prices, as a rule, are a shade easier, Arley Mine being quoted at 13s. to 14s., and good Pemberton four-feet 11s. to 12s. per ton. For furnace coal there is very little legitimate demand, and colliery proprietors are pushing off this class of fuel as much as possible for common house fire purposes, prices at the pit not ranging more than 9s. per ton. For burgy and slack there is a moderately good inquiry, at late prices; and the latter class of fuel is not so plentiful, owing to the quietness in the coal trade. Burgy runs from 6s. to 6s. 6d. per ton at the pit, good slack about 4s. 6d., and common ditto 3s. to 4s. per ton.

For gas-making coal there has been very little inquiry during the past week, beyond what is required to cover contracts, and prices remain without change.

There is no improvement to report in the coke trade, except that there have been a few inquiries from outside quarters. The local demand is very dull, and best Lancashire foundry cokes are offering at 21s. to 22s. per ton, delivered into the Manchester district.

The iron trade of this district has been very inanimate during the past week. There have been very few legitimate inquiries in the market, and prices are again easier, with a good deal of indirect underselling to secure orders. Manufactured iron has been generally dull, with a weakening tendency for some descriptions. Lancashire bars delivered into the Manchester district are quoted at £7 15s. to £7 17s. 6d.; Middlesbrough at £7 15s. 2d.; Staffordshire about £8 2s. 6d. per ton; puddled bars are quoted at £5 12s. 6d. to £5 15s.; billets at £5 15s.; angle iron £8 12s. 6d.; ordinary ship plates £8 15s. 2d.; and ordinary boiler plates £9 15s. per ton.

Forge proprietors are moderately employed, but they have little or no work forward, and in many cases the orders on hand are not more that sufficient to carry them over a couple of weeks. With the exception that there is a fair demand for builders castings, founders are very poorly supplied with orders, and in some cases have not sufficient work on hand to keep them going full time.

THE COAL AND GENERAL TRADE OF THE NORTH OF ENGLAND.

(FROM OUR OWN CORRESPONDENT.)

Last week was one of the dullest upon record in the coal trade. At present the coal trade of the North of England is subjected to keen competition from the Welsh, the Yorkshire, and the Scotch collieries. They are all from 1s. to 2s. per ton below north country rates. There has been a falling off in orders, and few, if any, contracts have been made in advance. In fact, there is a prevailing opinion amongst merchants that the price of coals must be lower before much business is done in the spring. The only coals which are moderately firm in the market are best gas coals. They remain at late quotations; but seconds are sold at from 7s. 6d. and upwards per ton, according to quality. As stated last week, one of the leading pits in the Northumberland steam coal trade reduced the price of best sorts from 14s. to 12s. 6d. per ton. Second-class steam coals, however, have been obtainable at from 10s. to 10s. 6d. per ton; but there is no great demand for any sort. There is a considerable amount of steam tonnage out of employment upon the Tyne. A fleet of steam coasters is laid up, and sailing ships for London and the by-ports are very much in excess of the demand. Freights for sailing ships have fallen fully 1s. per ton. For London, 4s. 6d. to 4s. 9d. is being paid to steamers. Havre 6s. 3d., Dunkirk 5s. 6d., Antwerp 6s. to 6s. 3d., and the other ports in proportion. The coal trade awards with regard to wages have not been made yet. But if the present deplorable condition of trade were continuing very long, whatever might be the reductions made by the arbitrators, there would have to be another fall of wages. At present foreign merchants refuse to buy in the market at the current rates. They state that Scotch or Yorkshire coals will suit their purpose as well, and they are cheaper. Business to Germany is very poor at present, and there is some fear of financial difficulties in Russia, which may keep business for the Baltic back in spring, and is at present checking all speculative business in that direction.

The difficulty in Middlesbrough and the Cleveland district, which arose the week before last in the iron trade, through many of the latter men refusing to abide by the award made in the iron trade with regard to wages, is settled; the men have gone in on the terms of the award. The iron trade of the North of England is quiet. It is neither better nor worse than it has been for a month. Work is limited, and any great amount of improvement which may be expected in the spring will largely depend upon the financial and political condition of the Continent at that time. The chemical and general trade of the North of England can be described as extremely dull. The chemical trade is in a very lifeless condition, and has shown no signs of improvement for months.

TRADE NOTES FROM SCOTLAND.

(FROM OUR OWN CORRESPONDENT.)

The movement that was started fully a year ago in connexion with the West of Scotland Gas Managers Association, in regard to a uniform pitch of screw for gas-pipes, has now begun to bear fruit. Hitherto every maker of malleable iron tubes for gas purposes has done what seemed best in his own eyes in this matter, but it is not unlikely that henceforth all of them will conform to a uniform pitch. Gas managers have complained, but in most cases they have had no power to carry out their views as to what they thought right; and they waited in the hope that some manager in a larger town would issue an order on the subject. This has now been done, or is contemplated, by Mr. Foulis, who, I believe, has resolved that all firms tendering for pipes for the Glasgow Corporation Gas Commissioners must guarantee that his pipes are screwed to the Whitworth gauge or pitch. Such a wise resolution on the part of Mr. Foulis is likely to carry great weight with it, and hence it may confidently be expected that the anomaly and grievance complained of will soon be done away with.

It may be remembered that about a year ago there was much dissatisfaction amongst the gas consumers of Blairgowrie, both with regard to the price and the quality of the gas supplied to the town. Eventually a reduction in price was made by the gaslight company, and great promises were made regarding the quality. Again the directors of the gaslight company have resolved to reduce the price—this time from 8s. 4d. to 7s. 6d. per 1000 cubic feet—the reduction to take effect from and after the survey in November last.

Some consternation has been caused at Newport, which is across the Tay from Dundee, by it becoming known that the resources of the gas-works are already overtaxed, and that from the difficulty of obtaining space for an additional gas-holder the directors may find it necessary not to undertake the supply of gas to the new houses now in course of erection or likely soon to be erected.

The Watching, Lighting, and Fires Committee of the Aberdeen Police Commission have lately been considering the question of the police-constables extinguishing the street-lamps, the Hon. Mr. Carnegie having intimated that if the practice were continued he would decline to recommend the continuance of the Government police grant. They had learned that the constables in Edinburgh, Glasgow, Dundee, Leith, Paisley, and Perth did not perform such a duty, and they recommended that the constables should be relieved of it, and that in future it should be discharged by the lamplighters—each man to extinguish the lamps on his own round.

Several specifications are in the market for gas-pipes of the larger sizes. During the high price of iron comparatively few orders were given out that could be held over, the opinion being that the price would by-and-by fall to something like a reasonable rate. Owing to the increase in the consumption of gas in many places, it is found that the gas-mains that were large enough two or three years ago are now too small, and hence there has been a sort of rush into the market with orders of late, and the effect is seen in the altered prices asked by founders. At present they are quoting 10s. per ton higher than they were doing for the larger sizes so recently as the early part of December, 1875.

There are likewise some specifications in the market for water-pipes. An order for a lot for the Elgin Police Commissioners has just been concluded, and in a few days a contract will be closed for a supply for Kirkby Lonsdale.

At the last meeting of the Glasgow Corporation Water Committee it was resolved that Mr. Gale, the engineer, should be allowed to obtain an assistant engineer. The quarterly report submitted by the engineer, regarding the condition of the works under his charge, stated that the entire cost of the work in progress in the Endrick Valley would amount to £39,700, and that the work would occupy the greater part of the present year. It was also stated that another piece of work would require to be undertaken, for giving an increased supply of water to the high-level districts on the south side of the city, and that the cost was estimated at £24,000.

Steps are, at length, being taken to introduce the Binn water into Burntisland. The inhabitants of Aberdour propose to pay 3d. per 1000 gallons for the Dour water, which will greatly lighten the rates for the inhabitants of Burntisland.

Latterly the Glasgow pig iron market has become quite inanimate; during two or three days of the past week very little business being done. On Friday forenoon only 1000 tons changed hands—one lot at 63s. 10½d. cash, and another at 64s. 6d. one month fixed. At the close of the forenoon market, sellers asked 63s. 10½d. prompt cash, buyers offering 63s. 9d. The market was quiet in the afternoon, but no business was reported, closing buyers offering 63s. 7½d., sellers asking 63s. 9d. cash.

The coal market has been very quiet during the past week, with prices slightly drooping for immediate orders. The mildness of the season has made house coal difficult to sell, even at lower prices than those now current. Shipping orders are also scarce, and altogether there is a dull feeling pervading business.

GAS LIGHTING IN BARBADOES.—A telegram from Barbadoes, dated the 15th of January, says: "This town was illuminated by gas last night for the first time. There was a public ceremony on the occasion, at which the authorities of the island were present."

RADIATION OF LIGHT.—Mr. Crookes, F.R.S., read a paper at the London Institution, on Thursday evening last, on the "Radiation of Light," in which he spoke of some practical applications that might be made of his discoveries. His scientific work is already well known, but these applications were for the first time laid before the public. He suggests that the "torsion balance," which he has throughout used for testing the amount of action caused by the approach of light to it, should be employed as a test for the purity of our gas supply. First he would test the quality of the "standard" candles used, which it is known really vary very much when that variation is regarded from the standpoint of scientific accuracy. Then with the "torsion balance" he would test the comparison between the gas and the standard candle, the slightest motion of the balance being capable of being recorded by the index scale on which the reflecting mirror shines. The other suggestion was the application of rotating apparatus to meteorological purposes. He has arranged the "windmill" rotating wires with pith balls, so that they carry round a small magnet suspended beneath them. Their rate of rotation depends on the amount of light that falls on them. Near the magnet attached to them is suspended another magnet which oscillates as the attached magnet presents alternately its north and south poles. This oscillation is arranged to "make" and "brake" an electric circuit which, by a wire that may be of any length, is connected with a recording Morse machine worked by clockwork. Each revolution of the rotating pith balls is thus recorded by a punch of the Morse on a strip of continuous paper, and so a self-recording account of the amount of light falling at any place may be kept. In our present meteorological records we notice heat, rain, and pressure of atmosphere; but light, the most important influence, both as regards health and agriculture, is neglected, because not till now have means of measuring it been known.

POLLUTION OF THE RAVENSBOURNE.—At a meeting of the Lewisham District Board of Works, on Thursday last, it was stated that fish to the number of thousands in the River Ravensbourne, a clear county stream, until recently the source of the water supply for the Kent Water-Works Company, had been found mysteriously poisoned and floating on the surface of the river, which had assumed a milky appearance. The tenants and owners of fields abutting on the river at once withdrew their cows, sheep, and horses from the land, lest the poisonous influence should extend to them, and considerable consternation prevailed. The parochial authorities of Lewisham, through whose parish the Ravensbourne flows, immediately took action, and ordered an exploration to be made up the stream, with the object of discovering the source of pollution. After proceeding about a mile, and coming to the junction of the Ravensbourne with the River Poole, near Perry Farm, the exploring party found that the Ravensbourne beyond the junction became suddenly clear, and that the water of the Poole was like lime-wash, emitting a horrible sulphurous smell. Attention was then directed to the Poole, and two miles further (in the parish of Beckenham) the explorers discovered a trench communicating with the brick-fields of Mr. Gascoyne. Along this trench was discovered flowing the watery portion of a large quantity of refuse lime carted from the Crystal Palace Gas-Works for the purpose of filling up a pit in the brick-fields, and which in this way found its way into the Poole, thence into the Ravensbourne, subsequently into Deptford Creek, and finally into the River Thames. The man at the brick-field who made the trench, when told of the full extent of the mischief he had thoughtlessly caused, immediately sent a letter of apology to the Lewisham Board of Works, and the Crystal Palace Gas Company have promised to send their refuse lime into Essex in future. A long discussion ensued as to whether the offending parties should not be prosecuted, and the clerk was ultimately instructed to write to Mr. Gascoyne and the gas company, asking if they have any explanation to offer.

WATER SUPPLY OF NEW YORK.—In 1870 the average daily consumption of water in New York city was 85 million gallons; in 1871, 87 million gallons; in 1872, 90 million gallons; in 1873, 100 million gallons; in 1874, 102 million gallons; in 1875, 107 millions. As the Croton aqueduct is now used to nearly its full capacity, the demand for water threatens to exceed ere long the amount which the aqueduct can deliver. About 340 square miles of territory are drained by the Croton River above the dam. On this area the rainfall is sufficient to furnish an average daily supply of 300 million gallons. The actual yield of the river is very much greater, showing that many of the springs which supply its tributary streams are fed from without the Croton water-shed. Croton Lake, which covers some 400 acres, has a storeage capacity of 500 million gallons. The old reservoir in Central Park holds 150 million gallons; the new reservoir 1000 millions, and the distributing reservoir on Fifth Avenue, about 20 million gallons; making a total of about 1670 million gallons. At or near the sources of the tributaries of Croton River, in Putnam county, there are many small lakes, some of them of great depth, which have been converted into natural reservoirs by lowering their outlets. Of these, Lake Glenida covers 122 acres, and will supply 168 million gallons, when drawn down 3 feet; Lake Gilead, 122 acres, drawn 12 feet, will supply 396 million gallons; Lake Mahopac, 603 acres, drawn down 3 feet, will supply 584 million gallons; Lake Kirk, 101 acres, lowered 20 feet, will supply 528 million gallons; Lake Barrett, 70 acres, lowered 10 feet will supply 198 million gallons; Lake China, 50 acres, lowered 10 feet, will supply over 132 million gallons; a total of over 2000 million gallons. Besides these natural reservoirs, there is an artificial reservoir at Boyd's Corners having a storeage capacity of 2700 million gallons, and an unfinished reservoir on the middle branch of the Croton which will have a storage capacity of 4000 million gallons. Thus the supply of storeage water, amounts to the enormous quantity of nearly 6000 million gallons, to be increased by the new reservoir to 10,000 millions. In 1868 there were 9 days when the daily flow of Croton River did not furnish a full supply of water for the city; in 1869, 80 days; in 1870, 107 days; in 1871, 35 days; in 1872, 30 days; in 1873, 109 days; in 1874, 85 days; in 1875, 39 days. —*Scientific American.*

EXTENSION OF THE BOLTON CORPORATION GAS-WORKS.—At the meeting of the Bolton Town Council on the 9th ult., the following report from the engineer on the necessity for enlarging the works at Lum Street was submitted by the Gas Committee:—

Gas Offices, Bolton, Jan. 4, 1876.

Gentlemen,—I have had to call your attention orally to the necessity of taking steps at once to add to the manufacturing power of the works by the erection of more retorts, and by increasing the purifying power. Now that we have had experience of the wants of our consumers this season, I am able to give figures to show the necessity for these extensions. From the commencement of November the whole of the retorts at both works have been in use, and as more gas has been required than could be made by working them by the ordinary six-hour charges, and with the ordinary heats of the furnaces, we have had to work off the gas in a shorter time and with more destructive

temperature. Even with the extra quantity thus made we have not been able to supply the wants of our consumers, and, as a consequence, many of the largest ones have had to complain, though I must say with a considerate forbearance. I may remark that in some cases the deficient supply has been caused partly by the too small bore of the main-pipes, particularly in districts which have become more populous, but on this subject I will make a subsequent report.

The pecuniary loss to the department by these drawbacks I consider to be as follows:—By the system of shorter charges the loss of gas per ton for the three months ending the 31st of January will be equal to 300 feet. This, multiplied by 13,572—the number of tons of coal and cannel used—will give 4,070,000 feet, which at 3s. 9d. per 1000 feet shows a loss of £763 2s. 6d. Through the excessive heat of the furnaces the retorts will only last one season instead of two, and as the annual cost of renewals is £1500, one half may be considered as lost. How far we have had to curtail the supply of gas will be shown by the fact that the pressure at the works in the evening in the middle of October was 22-10ths inches, whilst in December it only averaged 17-10ths inches. Had we been able to have given a proper supply, there is no doubt that there might have been a quarter of a million of feet more used during each of six days of the week, or 1,500,000 per week, giving a total of 19,500,000 feet for three months; the loss of this at 1s. 6d. per 1000 feet would be £1462 10s. These three sums represent a loss of £2975 12s. 6d. to the income of the department, without taking into account the increased cost of labour in purifying.

To prevent a repetition of this unsatisfactory state, I beg to recommend that a retort stack be erected at the Lum Street works, containing 140 retorts, and that the apparatus for condensing, scrubbing, and purifying be enlarged to a capacity for manipulating three millions of feet per day. To show the necessity of this extension, I may state that in December, 1863, there were made at the Gas Street works 8,449,000 feet; last December the quantity was 20,906,000 feet, being an increase of 12,457,000 feet, being at the rate of 147 per cent. At Lum Street works the quantity has increased during the same months from 9,041,000 to 43,766,000, being a difference of 34,725,000, or at the rate of 384 per cent., and yet the purifying power has not been increased at all. It has only been by strained efforts, at extra cost, that the work of purifying has been accomplished. As it is, a considerable amount of ammonia has been passed along with the gas, as is shown by the monthly reports of your consulting chemist, Mr. Watson. The gas is not deteriorated in illuminating power by this impurity to any perceptible extent, but it is a great loss to the revenue of the department.

The proposed rearrangement of the works at Lum Street has been shown on plan, and appears to have met with your approval. Assuming this to be adopted, we should then have 8 purifiers, each 20 feet square, in place of 8 of 12 feet square; a set of condensers, three "tower" scrubbers, and an additional boiler and exhauster. There would also be ample liquor and tar stores and increased sidings, which would economize the delivery of cannel and coal.

The estimated cost of these will be as follows:—

Retort stack, pipes, hydraulics, and other ironwork	£2800
Exhauster engines, &c.	500
Additional boiler	500
Condensers	1200
Scrubbers	3500
Purifiers, valves, &c.	5000
Purifying-house, including pillars to purifiers	4500
Tar stores, engine-house, pipes, chimney, &c.	2500
Total	£20,500

Removal of cottages, extension of sidings, erection of boundary walls, may bring this total up to £30,000.

The removal of the 16 cottages north of the entrance, the erection of boundary wall in Lum Street, of the retort stack and purifying-house, should be commenced at once, so that we may have the advantage of the enlarged works by next winter.

I am, gentlemen, your obedient servant,
HARRISON VEEVERS, Engineer and Manager.

To the Chairman and members of the Gas Committee, Bolton Corporation.

The Gas Committee had resolved that it is desirable the borough surveyor should assist in preparing plans for extensions at Lum Street works, and that the chairman (Alderman Glaister) and engineer confer with the borough surveyor on the subject. The proceedings of the Gas Committee were approved and confirmed by the council.

GAS EXPLOSION AT BOSTON, U.S.A.—The *Scientific American* says: A singular explosion occurred in South Boston on the evening of December 22, 1875. A large gas main, running under the Federal Street Bridge and along Federal Street, exploded, tearing up the pavement, killing and wounding a number of people, and blowing others into the water. It is supposed that gas had escaped from a defective-pipe until the ground had been saturated by an explosive mixture of gas and air. How it was fired is not known. The main-pipe, about 5 inches in diameter, passes through under Federal Street Bridge, and along the causeway leading from it up Dorchester Avenue, the continuation in South Boston of Federal Street. This causeway is composed of three feet or more of dirt and gravel, with the pavement resting on a foundation of piling, and on either side, for 17 feet or more, is the river. Eye witnesses state that a bright flash was first seen about the middle of the causeway, followed by a sharp explosion, and paving stones, gravel, and *débris* flying in all directions. Almost immediately the causeway on the right hand side fell over into the river, carrying over with it several persons. The number of these is not yet ascertained, but it is feared several were buried under the *débris* at the botttom of the river. The pavement was completely torn up for a distance of 175 feet from the wooden portion of the bridge to Crosby's warehouse, which was seriously shattered. Had the explosion occurred five minutes later the loss of life would have been far greater, as the draw of the bridge had been up for some time, and a crowd of 300 or 400 persons, on their way from the city to their homes in South Boston, had collected on this side, and in a few minutes would have swarmed upon the causeway. An explosion in one of the city culverts of Philadelphia, Pa., accompanied by the rupture of a gas main and the upheaval of inlet covers and the iron tops of manholes, coming soon after the fatal occurrence of a somewhat similar nature in Boston a few days ago, has led the *Public Ledger* of the former city to make some inquiry into the fact. It does not appear that the explosion came from any contact of inflammable gases with fire, as there is no account of any flames having been seen by any one. A rupture of a small gas main seems to have been an incident of the violence, and not the cause of it. The damage appears to have been occasioned by confined air, compressed within the culvert by the backing up of the tide water of the river to such a degree as to break out through the inlets and manholes with great force. This is not an unusual occurrence, and not by any means so dangerous as the ignition and explosion of inflammable gas in a culvert would be.

Register of New Patents.

APPLICATIONS FOR LETTERS PATENT.

246.—MOORE, J., Wolverhampton, "An improved apparatus to be employed in relieving the pressure in gas-retorts." Jan. 21, 1876.

249.—VAUGHAN, E. P. H., F.C.S., Chancery Lane, London, "An improved fire-alarm and gas intercepter." A communication. Jan. 21, 1876.

251.—LAKE, W. R., Southampton Buildings, London, "Improvements in fixed nozzle injectors." A communication. Jan. 21, 1876.

253.—SMITH, T., Bannockburn, N.B., "Improvements in water-closets and analogous apparatus." Jan. 21, 1876.

261.—PALMER, J. D., Camberwell, London, "Improvements in the construction and arrangement of burners used for illuminating purposes in which gas is employed as the illuminating medium for diffusing light." Jan. 22, 1876.

262.—LAKE, W. R., Southampton Buildings, London, "Improvements in the manufacture of gas, and in the utilization of the same for illuminating, heating, and ventilating purposes, and in apparatus therefor." A communication. Jan. 22, 1876.

264.—JOHNSON, S. H., F.C.S., Stratford, London, "Improvements in the preparation of ferro-cyanides from spent oxide of iron." Jan. 22, 1876.

268.—WEBB, C. B. S., Stratford, London, "Improvements in taps and valves." Jan. 24, 1876.

273.—JOHNSON, J. H., Lincoln's Inn Fields, London, "Improvements in apparatus for cleansing water from impurities." A communication. Jan. 24, 1876.

281.—BRINJES, J. F., Whitechapel, London, "Improvements in apparatus for raising, forcing, and exhausting water or other liquids, also air and gases." Jan. 25, 1876.

314.—SHAW, B., Huddersfield, "Improvements in 'tubs' or receptacles for sanitary purposes." Jan. 26, 1876.

322.—SCOTT, H. Y. D., Ealing, Middlesex, "Improvements in the treatment of ammoniacal and phosphate compounds for the manufacture of manures." Jan. 26, 1876.

PATENTS WHICH HAVE PASSED THE GREAT SEAL.

2742.—BUCKNILL, J. T., Whitehall, and CASELLA, L. P., Holborn Bars, London, "Improvements in gauges for indicating fluid pressures." Aug. 4, 1875.

2826.—HALLEWELL, R., Blackburn, "Improvements in gas motor-engines." Aug. 11, 1875.

3704.—CLELAND, W., Linacre, Lancs, "Improvements in apparatus used in the manufacture of gas made from coal, cannel, shale, and like materials." Oct. 26, 1875.

3920.—DEACON, H., Widnes, Lancs, "Improvements in apparatus for exposing porous materials and currents of gases to mutual reactions." Nov. 11, 1875.

3934.—BENNIE, G., Glasgow, "Improvements in retorts and their fittings and appurtenances connected therewith for the distillation of shale, coal, or other oleaginous or bituminous minerals or earths." Nov. 12, 1875.

PATENTS WHICH HAVE BECOME VOID

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £50 BEFORE THE EXPIRATION OF THE THIRD YEAR.

136.—HOLMAN, S., "Improvements in apparatus for raisiag and lowering heavy bodies, particularly applicable to the lids of gas-purifiers." Jan. 13, 1873.

168.—TARGET, J. L. F., "Improvements in treating excreta and sewage matters, and in apparatus employed therein." Jan. 15, 1873.

183.—SCOTT, H. Y. D., "Improvements in the purification of coal gas." Jan. 16, 1873.

Share List of Metropolitan Gas and Water Companies.

(Corrected by Mr. F. N. GOLDING, *Sun Court, Cornhill, from the latest Stock Exchange Quotations.)*

Number of Shares issued.	Amount per Share.	Name.	Amount paid up per Share.	Last Divd. p.Cent. p. Ann.	Latest Quotations.
	£	GAS COMPANIES.	£ s. d	£ s. d	£
8000	20	Angio-Romano . .	20 0 0	10 0 0	14—16
5000	20	Bahia (Limited). .	20 0 0	..	10—11
1000	20	Do., preference .	20 0 0	..	25—27
1000	20	Do., do., redeem.	20 0 0	..	20—22
1500	20	Do., perpet. pref.	20 0 0	7 10 0	19—21
40000	5	Bombay (Limited).	5 0 0	7 0 0	7¼— 8
10000	5	Do., fourth issue.	4 0 0	7 0 0	1½-2 pm.
10000	20	British (Limited) .	20 0 0	10 0 0	37—39
7500	20	Cagliari (Limited).	20 0 0	5 0 0	14—16
5500001.	Sk.	*Commercial*. . . .	100 0 0	10 0 0	196—198
20000	20	Continental Union.	20 0 0	8 0 0	21½-2½xd
20000	20	Do., new	12 10 0	8 0 0	1—½ pm.
10000	20	Do., preference .	20 0 0	7 0 0	26—28
5000	10	*Crystal Palace Dis.*	10 0 0	10 0 0	19—20
5000	10	Do., preference .	10 0 0	6 0 0	13—14
10000	7	Do., ordinary . .	10 0 0	7 0 0	12½—13
2500	10	Do., converted .	2 0 0	10 0 0	3—4 pm.
2500	7	Do., converted .	2 0 0	7 0 0	1-1½ pm.
23405	10	European(Limited)	10 0 0	10 0 0	16½—17½
12000	10	Do., new shares .	7 10 0	10 0 0	5-5½ pm.
35406	10	Do., new shares .	5 0 0	10 0 0	3¼-4¼pm
222656	10	*Gaslight & Coke* A.	10 0 0	10 0 0	19½—20
10000	10	Do. B.	10 0 0	4 0 0	8—8½
703	10	Do. 5 per ct. pref. conv., 1st issue.	10 0 0	5 0 0	18½—18⅝
627	10	Do. do., 2nd do. .	10 0 0	5 0 0	18½—18⅝
30000	10	Do. do., 3rd do. .	10 0 0	5 0 0	16½—17
50000	10	Do. do., 4th do. .	4 0 0	5 0 0	5—5¼
50000	10	Do. 5th do. .	2 0 0	..	4¼-4¾pm
20000	10	Do. C 10 p.c. pref.	10 0 0	10 0 0	22½—23½
12000	25	Do. D do. do. .	25 0 0	10 0 0	56—58
6200	5	Georgetown, Guiana	5 0 0	5 0 0	..
5300	10	Hong Kong (Lim.)	10 8 0	12 0 0	15—16
3500	10	Imperial Continental	10 0 0	10 0 0	15—16
1000	10	Kilburn	10 0 0	10 0 0	18—19
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The GRAND MEDAL of MERIT at the VIENNA EXHIBITION has been AWARDED to

GWYNNE & BEALE'S PATENT IMPROVED GAS-EXHAUSTERS,

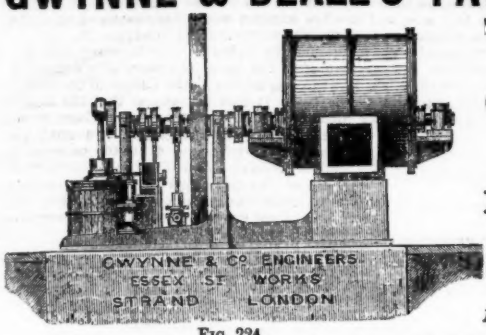


FIG. 224.

The BEST EXHAUSTERS IN THE WORLD.

GWYNNE & CO.

HAVE MADE THE

LARGEST AND MOST PERFECT

EXHAUSTING MACHINERY

Ever produced, and the most economical in working.

Prices and every information on application.

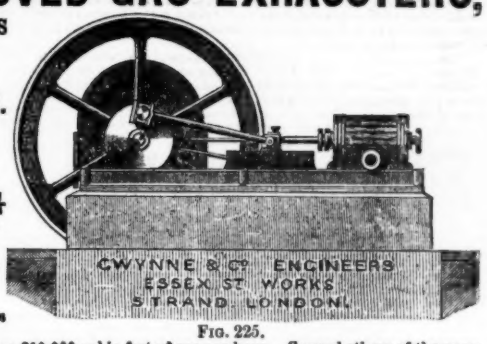
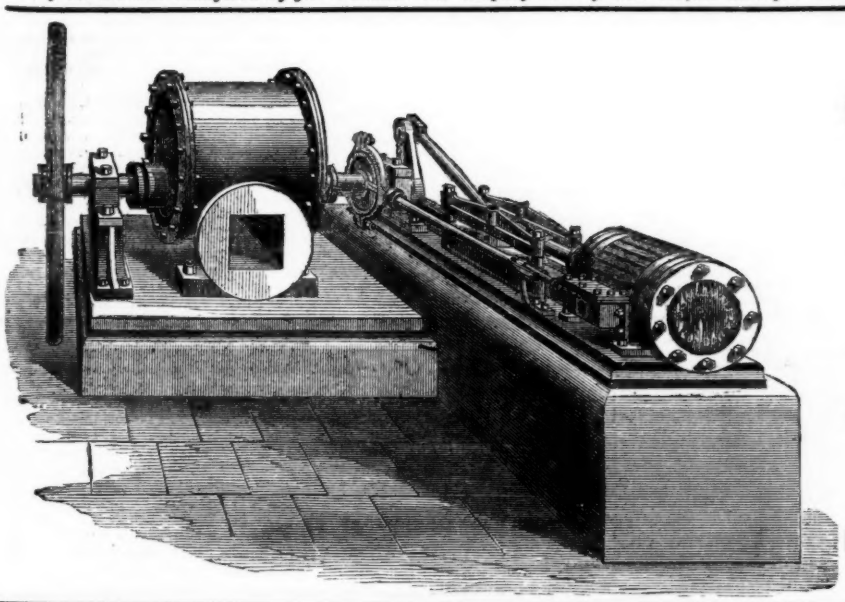


FIG. 225.

Fig. 224 represents one of those erected at the Imperial Gas-Works, Bromley, capable of passing 210,000 cubic feet of gas per hour. Several others of the same size are now on order for the same Company. These Patent Machines combine the highest quality of workmanship and materials, the largest bearings and wearing surfaces, with the **most perfect system of action yet discovered.** Fig. 225 represents one of a series of four at the Nottingham Gas-Works, each passing 52,500 cubic feet per hour. GWYNNE AND CO. *do not pretend to enter into a struggle with other makers in respect to cheapness. They have never sought to make price the chief consideration, but to produce Machinery of the very highest quality, and the most approved design and arrangement.* Their prices have been estimated with a due regard to the **excellence of the article produced,** and when this is taken into consideration, they have no fear for the result. The orders executed this season for Exhausters and alterations to their patented system amount to over 4,000,000 cubic feet of gas passed per hour, and to over 300 horse power for Engines to drive them. In every instance their work is giving the greatest satisfaction. Numerous testimonials and references can be given.

REGULATORS, BYE-PASSES, STOP-VALVES, GAS-VALVES, & MACHINERY FOR GAS MANUFACTURE, OF ALL SIZES,
CAN BE HAD ON APPLICATION TO
GWYNNE & CO., HYDRAULIC & GAS ENGINEERS, ESSEX STREET WORKS, STRAND, LONDON, W.C.
G. & Co. are now manufacturing for a London Gas Company three of their 210,000 *cubic feet Patent Gas Exhausters, and many of all sizes.*



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Improved Patent

GAS-EXHAUSTERS

WITH

ENGINES COMBINED.

Sole Makers,

GEORGE WALLER & CO.

Makers of
ENGINES, EXHAUSTERS,
INDEX and DISC GAS-VALVES,
HYDRAULIC MAIN VALVES,
BYE-PASS VALVES,
TAR, LIQUOR, and other PUMPS,
SCRUBBERS and PURIFIERS,
CONDENSERS, BOILERS, &c.

PHŒNIX ENGINEERING WORKS,
HOLLAND STREET, S.E.,
AND
STROUD, GLOUCESTERSHIRE.

D. BRUCE PEEBLES & CO.,

ENGINEERS,

FOUNTAINBRIDGE WORKS, EDINBURGH,

MANUFACTURERS OF WET AND DRY GAS-METERS:

Patentees and Sole Manufacturers of PEEBLES' LAMP-GOVERNORS,

ABOVE 30,000 OF WHICH ARE NOW IN USE.

"These Lamp-Governors are so superior that they are likely to supplant all others."—*Dr. Wm. Wallace, F.R.S.E., F.C.S.*

D. BRUCE PEEBLES AND CO., FOUNTAINBRIDGE WORKS, EDINBURGH.

WANTED, by the Advertiser, a situation as GAS-FITTER, Main or Service Layer, Meter Inspector, or to take charge of small works. Has had 17 years experience. Good reference.

Address No. 237, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, by a Working Manager of a GAS-Work, a SITUATION. Can do main and service laying, meter fixing, setting of retorts, clay or iron. Twelve years testimonials. Abroad preferred.

Address No. 244, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Working Manager, to take charge of a small Gas-Work in North Wales. One capable of laying mains, gas-fitting, &c. House, coal, and gas.

Address, stating wages required, and all particulars, to No. 1, care of Mr. G. W. Hughes, 4, Cable Street, LIVERPOOL.

SHEFFIELD UNITED GASLIGHT COMPANY.

WANTED, by the above Company, an experienced resident SUPERINTENDENT, to take charge of a Gas Station capable of producing 3 million cubic feet per day. He must thoroughly understand the manufacture and distribution of gas.

Applications to be addressed to the CHAIRMAN, giving references, and stating age and salary required.

TO GAS ENGINEERS.

AN Engagement is desired by a Gentleman, aged 28, experienced in preparing drawings, superintending the erection of, and starting, private and other Gas-Works. Also in retort and furnace setting, iron roofs, &c. A good Draughtsman, Correspondent, and Accountant. Testimonials of the highest order can be given from all previous employers and others.

Address DELTA, 5, Bell Yard, DOCTORS' COMMONS, E.C.

OLD BOOKS on Gas Lighting for Sale, comprising Winsor's Traité sur l'Eclairage par le Gaz, with Plates and the Author's Signature, dated 1815. Accum's Treatise, Second Edition, 1815. Accum's Treatise, Third Edition, 1819; and Peckstone's Treatise, 1819. Price three guineas.

Apply, by letter, to No. 245, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

ADVANTAGES OF GAS FOR

COOKING AND HEATING.

HINTS ON GAS BURNERS, &c.

By MAGNUS OHREN, A.I.C.E., F.C.S.

Specimen Copy by post Threepence, direct from MAGNUS OHREN, Gas-Works, Lower Sydenham, London, S.E.

FOR SALE—Gasholder, 30 ft. by 10 ft.; one new ditto, 20 ft. by 10 ft.; one ditto, 18 ft. by 10 ft., in iron tank complete; one ditto, 9 ft. by 8 ft., in iron tank complete. Also two ditto for experimental purposes. Two Purifiers, one 8 ft. by 5 ft. by 3 ft. double; one ditto, 4 ft. by 4 ft. by 3 ft. 3 in. complete. One 4-in. Condenser, with 120 ft. of pipe complete. All connexions of above are 4-in. To be sold together or separately, and cheap.

Address No. 243, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

LEICESTER WATER-WORKS.

THE Directors of the Leicester Water-Works Company are prepared to receive TENDERS for the construction of a covered service RESERVOIR at Gilroes, near Leicester.

Drawings and specifications may be inspected, and forms of tender and schedule of quantities may be obtained, at the Offices of the Company, Bowling Green Street, Leicester, and at the Office of Messrs. Thomas and Charles Hawksley, Civil Engineers, 30, Great George Street, Westminster, S.W., on and after Monday, the 24th day of January inst., and tenders must be delivered at the Offices of the Company, at or before Ten o'clock in the forenoon of Saturday, the 19th day of February next.

The Directors do not pledge themselves to accept the lowest or any tender. By order,

J. H. WILLIAMS, Secretary to the Company.

Leicester, Jan. 17, 1876.

CITY OF DURHAM.

GAS MANAGER.

THE Directors of the City of Durham Gas Company are desirous of obtaining the services of a practical experienced MANAGER for their Gas-Works. Present make of gas about 53 millions per annum.

Applications, in own handwriting, stating age, experience, and salary required, accompanied with testimonials, endorsed "Gas Manager," to be sent on or before Monday, the 7th of February, addressed to the CHAIRMAN, Gas Company, DURHAM.

WIDNES WATER-WORKS.

THE Widnes Local Board are prepared to receive TENDERS for the construction of a covered RESERVOIR (to contain 10 million gallons), to adjoin their present one on Pex Hill.

Plans may be seen, and specifications obtained, at the Engineer's Office, Public Offices, Widnes, on and after the 27th inst.

Tenders to be addressed to the Chairman of the Gas and Water Committee, endorsed "Reservoir," and delivered at the above Offices not later than the 4th of March next.

The Board do not bind themselves to accept the lowest or any tender.

HENRY ROBERTS.

Widnes, Jan. 19, 1876.

EXETER GASLIGHT AND COKE COMPANY.

THE Directors of the above Company invite TENDERS for the supply of from 5000 to 10,000 tons of North Country GAS COALS (unscreened), such coal to be either of the following descriptions:—New Pelton, South Pelton, Holmside, Pelaw Main, or coal of equal quality, and to be shipped, f.o.b., at Newcastle or Sunderland during the present year.

The Contractor to state for which coal he tenders.

Sealed tenders, endorsed "Tender for Gas Coals," to be sent to me, the undersigned, on or before the 14th day of February next.

The Directors do not bind themselves to accept the lowest or any tender.

W. A. PADFIELD, Secretary.

TO IRONFOUNDERS.

THE Directors of the Flint Gas and Water Company (North Wales) are prepared to receive TENDERS for about 2800 yards of 6-in. SOCKET-PIPES, turned and bored. Weight 86 lbs. per yard. Proved to sustain a pressure of 200 ft. head of water, and perfect in every respect. Also for the necessary connexions and a few Double-Faced Sluice-Valves, with brass faces and screws.

The whole to be delivered free at the Railway Station, Flint, North Wales.

Tenders to be delivered on or before the 5th of February next, addressed to Mr. WM. RICHARDSON, Gas and Hydraulic Engineer, 62, Pershore Road, Edgbaston, BIRMINGHAM.

The Directors do not bind themselves to accept the lowest or any tender.

TO TAR DISTILLERS, MANUFACTURERS, AND OTHERS.

THE Directors of the Phœnix Gaslight and Coke Company are prepared to receive TENDERS for the purchase of the TAR made at their respective stations, at Vauxhall, Bankside, and Greenwich, for the period of One, Two, or Three years from the 1st day of April ensuing.

The quantities will be approximately: Vauxhall, 1,000,000 gallons, Bankside, 280,000 gallons, and Greenwich, 360,000 gallons, in twelve months; total, 1,640,000 gallons. Tenders may be made for one or more of the stations.

Forms of tender, and conditions of contract, may be had upon application to the Secretary, 70, Bankside.

Tenders, endorsed "Tenders for Tar," to be delivered at this Office on or before Wednesday, the 1st of March, at One o'clock p.m.

The Board do not bind themselves to accept the highest or any tender.

By order of the Court of Directors,
I. A. CROOKENDEN, Secretary.
70, Bankside, S.E., Jan. 25, 1876.

WINDSOR DRAINAGE.

THE Urban Sanitary Authority for the Urban Sanitary District of New Windsor are prepared to receive TENDERS for the construction of PRECIPITATING-TANKS, ENGINE-HOUSE, SEWERS, DWELLING-HOUSE, and other works, to be situated on the "Ham," at Old Windsor.

Drawings and specifications may be seen at the Office of the Clerk to the said Sanitary Authority, in Sheet Street, Windsor, or at the Offices of Messrs. T. and C. Hawksley, 30, Great George Street, Westminster, on and after Wednesday, the 26th day of January instant, where copies of the bills of quantities may be obtained on payment of three guineas, which sum will be returned if a *bonâ fide* tender be made thereon.

Tenders must be delivered at the Office of the Clerk to the said Sanitary Authority, at or before Four o'clock in the afternoon of Wednesday, the 9th day of February next.

The Sanitary Authority do not undertake to accept the lowest or any tender.

By order,
CHAS. THOS. PHILLIPS,
Clerk to the said Urban Sanitary Authority.
1, Sheet Street, Windsor, Jan. 25, 1876.

THE Sheffield United Gaslight Company have for SALE the following Articles:—

The whole Manufacturing Plant, Gasholder, and Governor, of a small Gas-Work, capable of producing 10,000 cubic feet of gas per day. The gasholder is 27 ft. diameter by 14 ft. deep, cubic contents 8000 ft.

Connexions for ditto.

Four Purifiers, 12 ft. square, with 10-in. centre-valve and connexions.

Two Purifiers, 12 ft. square with 18-in centre-valve.

Two Jones's Exhausters, each to pass 25,000 cubic feet per hour, with valves and connexions, in good condition.

Two 7-in. Governors.

One Scrubber 8 ft. diameter, 18 ft. high, with 12-in. connexions and valves.

One Battery Condenser, 60 ft. long, 12 ft. high, and 2 ft. wide, with 14-in. connexions and valves.

Seven Lengths Hydraulic Main, 7 ft. long, 18 in. diameter.

Nine Lengths Hydraulic Main, 7 ft. long, 14 in. diameter.

Twenty-seven Dip-Pipes, 4 in. diameter.

Twenty-seven Bridge-Pipes, 4 in. diameter.

Full particulars as to quality and price can be obtained on applying to Mr. T. ROBERTS, the Manager, Commercial Street, SHEFFIELD.

SOUTH METROPOLITAN GASLIGHT AND COKE COMPANY.

NOTICE is hereby given that an EXTRAORDINARY MEETING of the PROPRIETORS of the South Metropolitan Gaslight and Coke Company will be held at the London Tavern, Bishopsgate Street, in the City of London, on MONDAY, the 14th day of February next, at Two o'clock p.m., for the purpose of considering the provisions of the Bill now before Parliament, intituled "A Bill to grant further powers to the South Metropolitan Gaslight and Coke Company." At such meeting the said Bill will be submitted for the consideration and approval of the Proprietors.

Dated this 24th day of January, 1876.

GEORGE LIVESEY,
Secretary and Engineer of the Company.
589, Old Kent Road, S.E.

IN THE MATTER OF

BRONNER'S GAS-BURNERS.

HENRY GREENE AND SON, 155, Cannon Street, London, Sole Agents for Great Britain, Ireland, and Colonies, of Brönner's Improvements in Gas Lighting, beg to inform the public that on the 13th of January, 1876, Julius Brönner obtained an injunction in the Court of Session, Scotland, against Donald M'Vean, Gas-Fitter, 14, Newton Street, Glasgow, prohibiting him from in any way advertising or offering for sale as Brönner's Burners, any Burner not manufactured by Julius Brönner, or from in any way inducing the public to believe that the said Donald M'Vean sells or keeps for sale Brönner's Burners, manufactured by Julius Brönner, while such is not the case.

Also that on the 9th of November, 1875, he obtained injunction in the same Court, and in the same terms, against R. M. Brechin and Co., 46, North Hanover Street, Edinburgh.

Also that on the 20th of April, 1875, in a suit in Chancery, before Vice-Chancellor Malins, number 1874, B 365, he obtained injunction against another defendant, in the same terms and on similar grounds.

T. NEWBIGGING,

CONSULTING GAS ENGINEER,

5, NORFOLK STREET, MANCHESTER.

Mr. ALFRED LASS,

60, CORNHILL, LONDON, E.C.,

Is prepared to open the Books, and, if necessary, keep the Accounts of Gas and Water Companies.

To examine the Books and Accounts, and prepare Balance-Sheets for the information of Directors.

To assist Secretaries in preparing Balance-Sheets, according to the "Gas-Works Clauses Act, 1871;" or may be consulted with respect to Accounts generally.

SURPLUS Plant for Sale, in good condition. A nearly new Beale's Exhauster and Engine combined, to pass 2000 feet per hour. Makers, George Waller and Co.

One 6 ft. square wrought-iron Purifier, with counterbalance lifting gear complete.

One wrought-iron vertical Washer, 11 ft. by 2 ft. by 1 ft.

One wrought-iron vertical Washer, 10 ft. by 2 ft. by 1 ft.

Apply to Mr. C. E. BOTLEY, Gas-Works, Wormwood Scrubs, LONDON, W.

TO GAS & WATER COMPANIES, & MUNICIPAL AUTHORITIES SUPPLYING WATER OR GAS.

CONSPIRACY AND PROTECTION OF PROPERTY ACT, 1875.

It is required, under a PENALTY OF FIVE POUNDS, that a PRINTED COPY of the 4th SECTION of the above Act shall be posted up at all Gas and Water Works in a conspicuous place, where the same may be conveniently read by the persons employed thereat.

Printed copies of the section, in large type, on broad sheets, may be had of WILLIAM B. KING, 11, Bolt Court, Fleet Street, LONDON. Price, per post, 2s. per dozen, or 10s. 6d. per 100.

The Act came into operation on Sept. 1, 1875, and extends to Scotland and Ireland.

JOURNAL OF GAS LIGHTING, WATER SUPPLY, AND SANITARY IMPROVEMENT.

CLOTH CASES, GILT LETTERED,
For binding Vol. XXVI., may now be obtained,
Price 2s. 6d.

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The JOURNAL OF GAS LIGHTING is supplied direct from the Office to residents in any part of the United Kingdom, at the rate of 21s. per annum, payable in advance. If credit be taken, the charge is 25s.

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WILLIAM SUGG,

GAS ENGINEER,

VINCENT WORKS, VINCENT STREET,

WESTMINSTER, S.W.

WILLIAM SUGG'S LATEST IMPROVEMENTS IN GAS-BURNERS.

The "LONDON" ARGAND BURNER, with SELF-ACTING GOVERNOR (Patent).

"Westminster" Pattern Shade, as used in the Ministers Rooms and Lobbies of the Houses of Parliament.

This Burner is No. D size, and, with a consumption of 5 cubic feet per hour, gives about 2 candles more light than the Gas Referees model, called the No. 1 "London" Argand Burner.

Numerous other pattern Shades, Plain or Ornamental, may be obtained with these Burners.

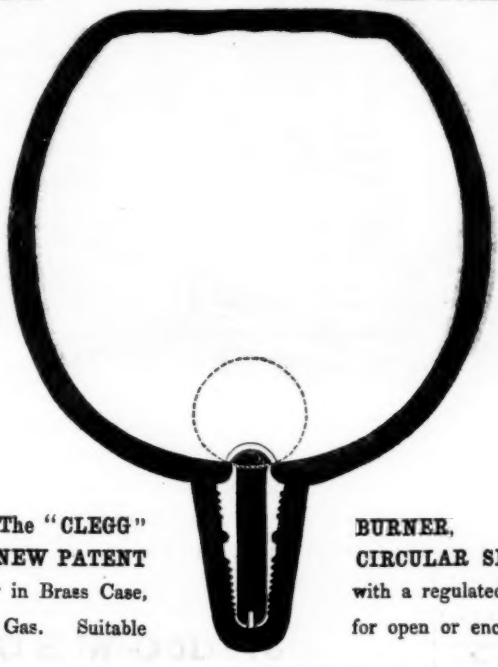
The "CHRISTIANIA" FLAT-FLAME BURNER, with SELF-ACTING GOVERNOR (Patent).

This Burner has been pronounced by the most eminent Engineers of the day to be the perfection of a flat-flame Burner.

The Shades, which are made in a beautiful white glass called Albatrine, are manufactured *exclusively* for these Burners, and cannot be obtained elsewhere.

The light emitted from these Burners is very white and soft to the eyes, and is about 30 PER CENT. superior to the ordinary fishtail.

The Shades may be had either Plain or Ornamental.



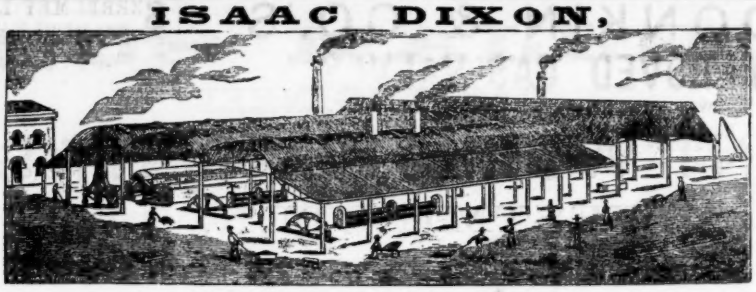
The "CLEGG"
with the NEW PATENT
Is a flat-flame Burner in Brass Case,
admission of Gas. Suitable

BURNER,
CIRCULAR SLIT,
with a regulated opening for the
for open or enclosed Lights.

Price Lists and Prospectuses, with description of all the "London" Argand and other Burners, and their proper Shades, Supports, &c., forwarded post free on application.

ISAAC DIXON,

WINDSOR IRON-WORKS, LIVERPOOL.



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Manufacturer of SELF-SUPPORTING GALVANIZED CORRUGATED, CURVED, and every kind of IRON ROOFING, CHURCHES, SCHOOLS, SHEDS, and IRON BUILDINGS.

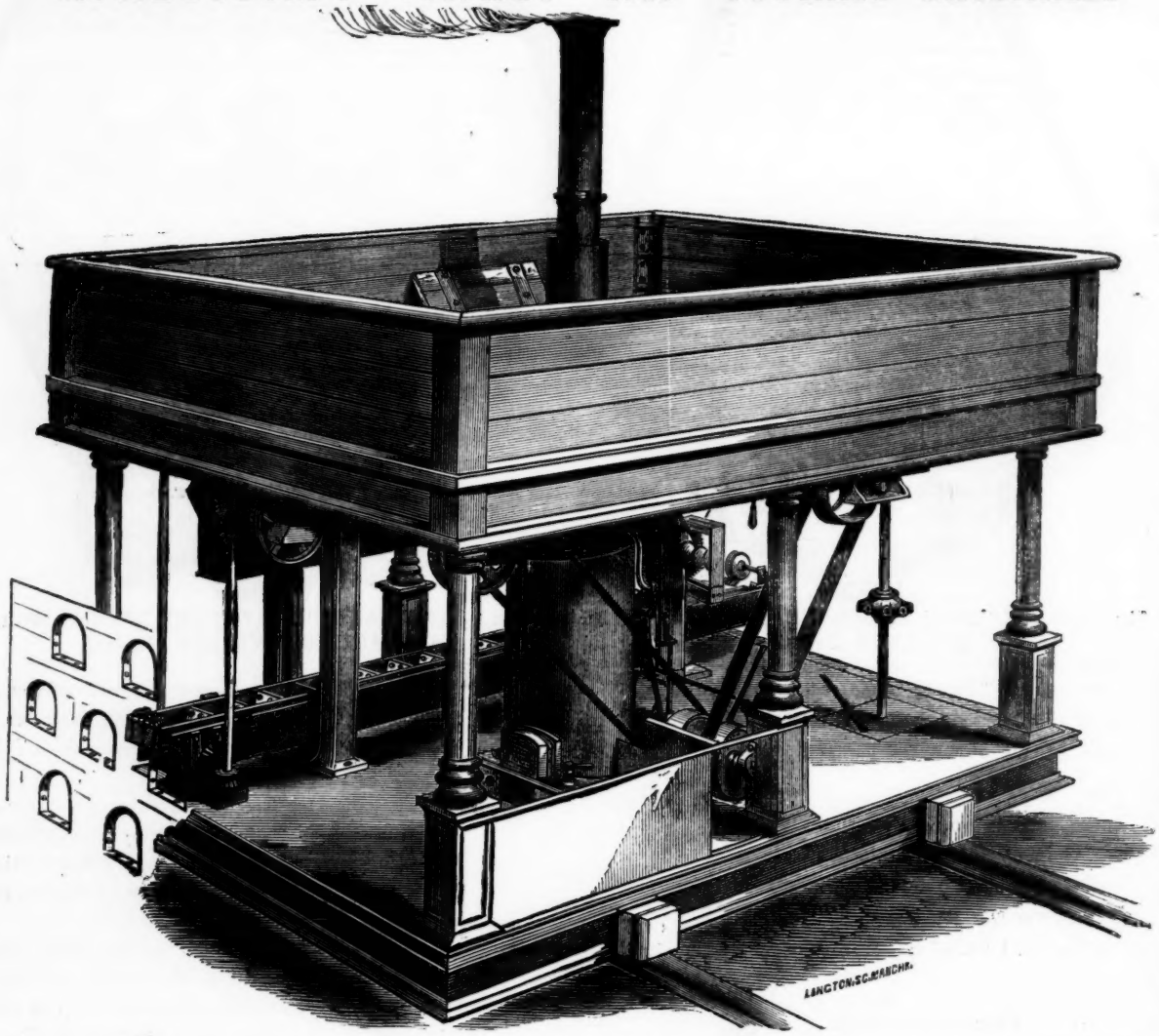
WROUGHT and CAST IRON GIRDERS, BRIDGES, TANKS, &c., and all kinds of WIRE WORK, FENCING, GATES, HURDLES, &c., for Home or Abroad.

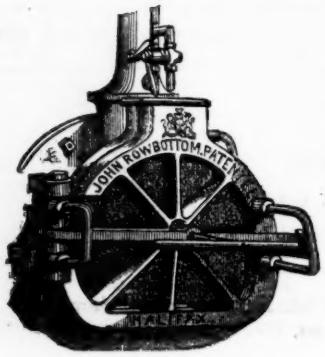
DIXON'S CELEBRATED SELF-SUPPORTING IRON ROOFS are specially suitable for Forges, Rolling-Mills, Iron-Works, Shipbuilding Yards, Mines, Collieries, Gas and Water Works, and for general purposes.

For Roofs with Timber Framing, DIXON'S GALVANIZED OR TARRED IRON SLATES form a durable and cheap covering, costing only about the same, when fixed, as felt and boards.

DRAWINGS, ESTIMATES, AND ILLUSTRATED CATALOGUES MAY BE OBTAINED ON APPLICATION.

ROWBOTTOM'S PATENT GAS STOKING-MACHINE.





By the adoption of this Machine, a saving of at least 50 per cent. in labour will be secured. A great saving of time is effected, as the pro-mover, which enters one end of the retort, discharges the coke at the other end, and on the return charges it with coal, thus increasing the effectiveness of the retort. The first cost, and the cost of working it, will be far less than that of any other Stoking-Machine.

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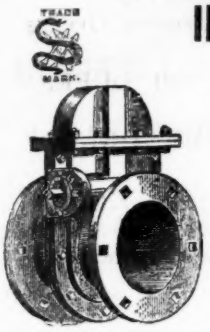
GAS ENGINEER,
2, CRIPPLEGATE, HALIFAX.

B. DONKIN & CO.'S
IMPROVED GAS-VALVES



WITH WROUGHT-IRON PINIONS,

List of prices, with full dimensions of all sizes up to 48-inch, to be had on application.

These Valves are all proved on both sides to 30 lbs. on the square inch before leaving the works, and are always kept in stock.

VALVES MADE WITH OUTSIDE RACKS TO ORDER.
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ALSO SOLE MAKERS OF
J. BEALE'S NEW PATENT GAS EXHAUSTERS.

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GENERAL ENGINEERS AND IRONFOUNDERS,
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55a, BLUE ANCHOR ROAD, BERMONDSEY,
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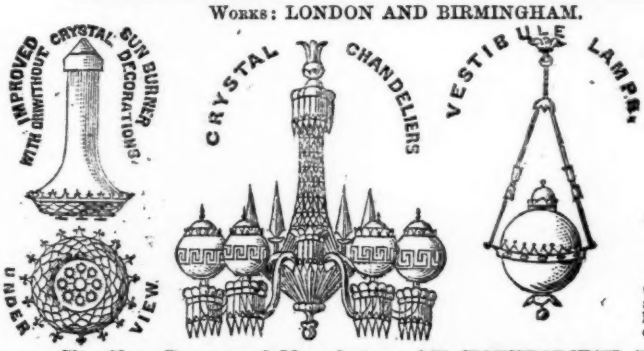
STREET LAMPS AND COLUMNS IN GREAT VARIETY.
WORKS: LONDON AND BIRMINGHAM.



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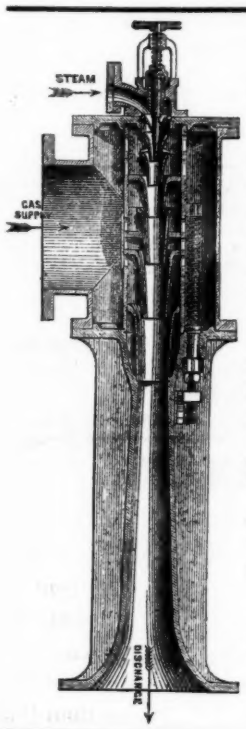

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SOLE LICENSEES FOR
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E. KÖRTING'S PATENT
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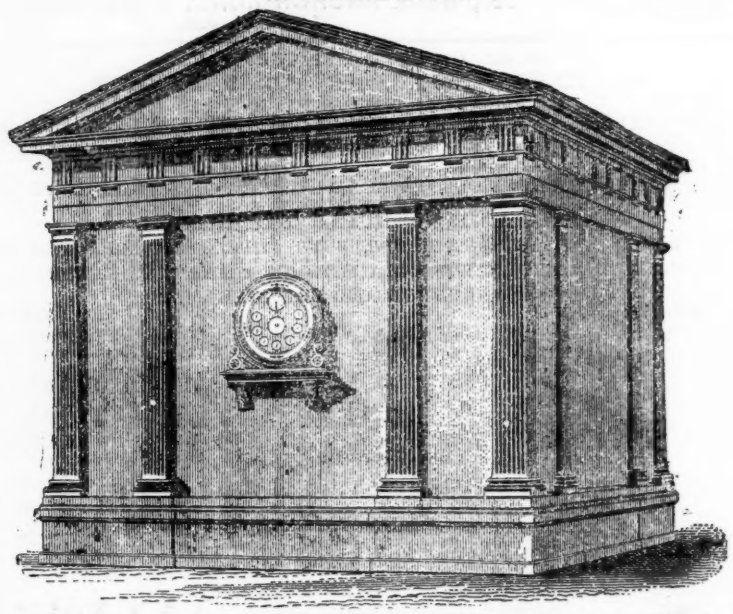

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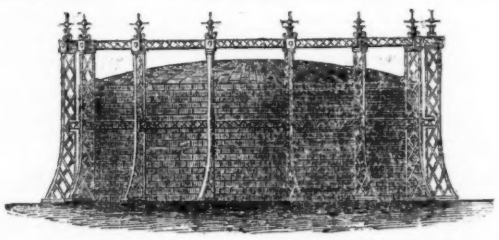

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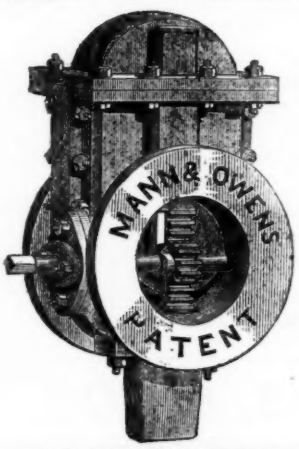
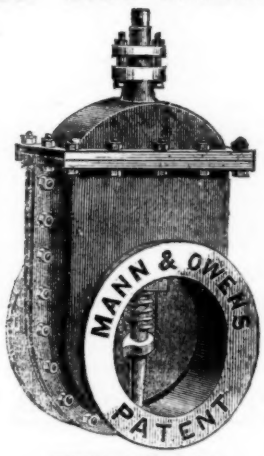


RACK AND PINION VALVE.



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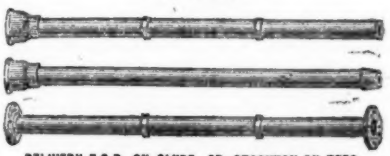

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Prices on application

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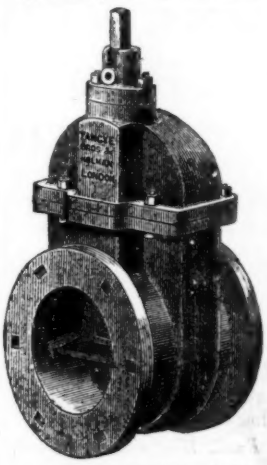

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4	36	0
5	40	0
6	54	0
7	63	0
8	80	0
9	85	0
10	100	0
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Analysis and Price on Application.

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Analysis by F. J. EVANS, Esq., Chartered Gas Company, Horseferry Road, Westminster:—

(COPY.)

	Cubic Feet of Gas per Ton of Coal.	Illuminating Power in Candles.	Coke per Ton of Coal used.	Ash in Coke, per Cent.	Sulphur in Coal, per Cent.
Silkstone Nuts . . .	10·800	15·85	12·66 cwt.....	6·0	0·69

NOTE.—The illuminating power of the gas was tested by the standard burner now used in London by the Gas Referees, under the City of London Gas Act, 1868.

Horseferry Road, Westminster, March, 1870. (Signed) F. J. EVANS.

These Nuts are extensively used by various Gas Companies throughout the Kingdom, who bear strong testimony to their value.

APPLICATIONS FOR PRICES, &c., TO BE SENT DIRECT TO THE COLLIERY, AS ABOVE.

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Of superior quality, delivered at any station in England and Wales.

Purified gas per ton of coal in cubic feet (average)	10,775
Weight of coke in lbs. per ton of coal	1,465

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This Company request attention to the very superior quality of their Cannel Coals.

1. The following are the practical results given by Dr. Wallace, of Glasgow, of analyses of their Lochore and Capledrae Cannels:—

	Sample worked at Capledrae.	Sample worked at Lochore
Gas per ton of coal, at 60° Fahr. and 30 inches barometric pressure . .	13,095 cubic feet.	11,760 cubic feet.
Illuminating power, in standard sperm candles, by union jet consuming 5 cubic feet per hour, at ·5-inch pressure	32·91	34·83
Value of 1 cubic foot of gas in grains of sperm	780	836
Equivalent of a ton of coal in pounds of sperm candles	1,459	1,404
Durability of 1 cubic foot by 5-inch flame	69 minutes.	71 minutes.
Gravity of the gas (air = 1000)	596	594

Remarks.—This (the sample from Capledrae) is a Cannel Coal of first-class quality, giving 13,000 feet of 33-candle gas. It contains only a minute proportion of sulphur, and the ash is almost quite white. The coke is of rather inferior quality.

Remarks on Sample from Lochore.—This is a Cannel Coal of first-class quality, giving a large yield of very rich gas and a coke of medium quality.

2. The following are the practical results of analyses by Dr. Wallace of the Company's Waverley Cannels:—

	Capledrae Waverley.	Lochore Waverley.
Gas per ton of coal, at 60° Fahr. and 30 inches barometer	9,120 cubic feet.	11,145 cubic feet.
Illuminating power, in standard candles, by union jet consuming 5 cubic feet per hour, at ·5-inch pressure	36·62	33·09
Value of 1 cubic foot of gas in grains of sperm	878	794
Equivalent of a ton of coal in pounds of sperm candles	1,145	1,264
Durability of 1 cubic foot of gas by 5-inch flame	80 minutes.	67 minutes.
Gravity of the gas (air = 1000)	677	597

Remarks on the Sample of Capledrae Waverley.—This Coal gives fully 9000 feet of gas of 36½ candles, and is admirably adapted for bringing up the quality of gas made from common coal or inferior qualities of cannel. The tests were made at a rather high temperature, this being one of the coals that stand a very high heat without serious diminution of the illuminating power of the gas The coke contains 60 per cent. of ash, and is therefore almost valueless, but the proportion of sulphur is very moderate.

Remarks on the Lochore Waverley.—This is a first-class Cannel Coal, giving 11,000 cubic feet of 33-candle gas. The quantity of sulphur is very minute, and the ash is nearly white. The coke is of inferior quality, but not wholly valueless.

Applications for full Copies of Analyses and Prices may be made to the Company, at

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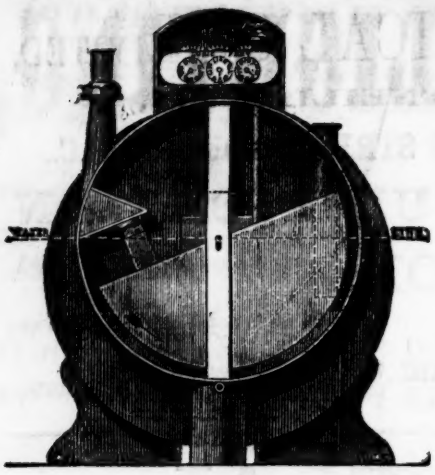

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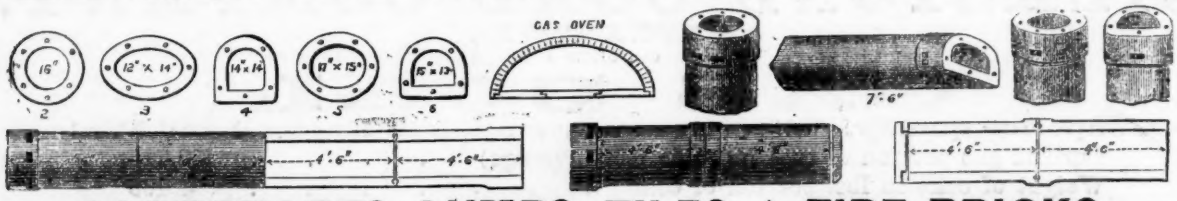

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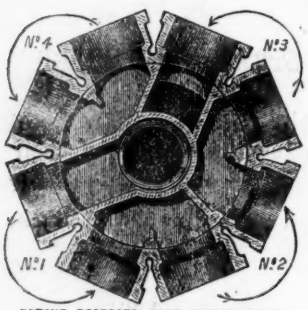

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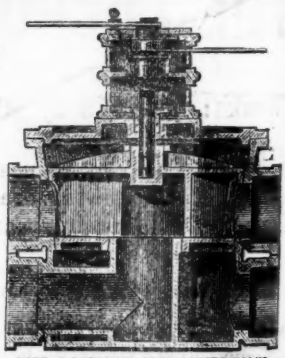

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